ENVIRONMENTAL ASSESSMENT

ISSUANCE OF AN INCIDENTAL TAKE PERMIT

TO

INDIAN RIVER COUNTY, FLORIDA

FOR

TAKE OF SEA TURTLES INCIDENTAL TO SHORELINE PROTECTION MEASURES INITIATED UNDER INDIAN RIVER COUNTY'S EMERGENCY PERMITTING AUTHORITY

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1.0 PURPOSE AND NEED FOR ACTION

1.1 Introduction

The County of Indian River, Florida (Applicant) is seeking an Incidental Take Permit (ITP) from the U.S. Fish and Wildlife Service (USFWS or the Service) pursuant to Section 10(a)(1)(B) of the Endangered Species Act (ESA or the Act) of 1973, as amended. The ITP would authorize the take of sea turtles on the Atlantic coast beaches of Indian River County (IRC or the County) incidental to shoreline protection measures initiated under an emergency permit issued by the County.

The Applicant has submitted a Habitat Conservation Plan (HCP) in support of the ITP application. Much of the social, economic, and environmental information presented in this Environmental Assessment (EA) has been drawn from the HCP, which is incorporated herein by reference.

IRC's Atlantic shoreline is 22.25 miles long. It is bordered to the north by the Brevard County Line at Sebastian Inlet and to the south by the St. Lucie County Line just south of Round Island Park (Figure 1). The incorporated Towns of Orchid and Indian River Shores and the City of Vero Beach share the coastline with IRC. Under inter-local agreements, the County has responsibility for managing all of the beaches in the County, including those within constituent municipalities. Thus, as used in this document, the term County Beaches includes both incorporated and unincorporated areas of IRC's coastline.

In 1996, IRC's population surpassed 100,000 with a reported annual growth rate over the past decade of about 2.1 percent (IRC 1998a). Ninety per cent of the County's residents live within 10 miles of the beach. Additionally, the primary industry in the County is tourism, and the most popular tourist destination is the beach (ATM 1999). Consequently, the County considers its beaches to be a vital economic asset.

It is estimated that County Beaches are losing approximately 187,218 cubic yards (cy) of sand per year to erosion (IRC 1998b). About 9.2 miles (41.3 percent) of the County's shoreline have been designated by the State of Florida as "critically eroded" (J. Tabar,

FIGURE 1
INDIAN RIVER COUNTY COASTLINE
SHOWING CONSTITUENT MUNICIPALITIES.

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IRC Coastal Engineer, personal communication, 2001). This term is applied to beaches where natural processes or human activity have caused erosion to such a degree that upland development, recreational interests, wildlife habitat and/or cultural resources are lost or threatened. The continued and unabated loss of sand from County Beaches is likely to have an adverse impact on the recreational and economic values of the County's coastline.

Erosion rates along County Beaches vary and are affected by the downdrift effects of inlets, prevailing currents, shoreline contours, adjacent water depths, and other localized physical features. Sebastian Inlet, at the north end of the County, is responsible for a large amount of the County's annual sand deficit. The extensive jetties that frame the inlet presently interrupt the longshore transport of about 72,400 cy of sand per year to downdrift beaches (Olsen Associates 1998). Prevailing littoral currents along the IRC shoreline are to the south. During flood tides, some of the sand that would normally flow south from Brevard County onto County Beaches is transported into the Indian River Lagoon where it settles to the bottom. During ebb tides, sand is carried offshore into deeper waters. In both instances sand is lost from the littoral system and a deficit results. It is estimated that erosion effects associated with the Sebastian Inlet have resulted in an historical deficit of 8.65 million cy of sand to downdrift beaches (Olsen Associates 1998). The area of impact extends up to 7.6 miles south of the inlet.

Due to the eroded nature of IRC's coastline, habitable structures adjacent to the beach have become increasingly vulnerable to physical damage from storms. To provide shoreline protection for upland properties and restore lost recreational values, the County has developed a long-term Beach Preservation Plan (BPP; Cubit Engineering 1988). The BPP partitions the coastline into discrete sectors, each having unique coastal features and erosional patterns. A multi-faceted approach was developed to manage the beach/dune system in each sector to accommodate these site-specific conditions. The BPP was last updated in 1998 (IRC 1998b).

Beach nourishment is one method that the County will use to address its shoreline protection needs. Beach nourishment involves the dredging and transfer of sand from inlets or offshore "borrow" areas onto eroded sections of the coastline. IRC's Beach Preservation Plan Update (BPPU) proposes four major beach nourishment projects, encompassing 8.3 miles of beach, or 37 percent of the County's coastline (IRC 1998b). The projects are scheduled to commence in 2002 and will be phased in over a four-year period. Once each project has been built, it will be replenished at approximately 8-year intervals over the next 30 years.

Until such time as the BPP is fully implemented, many beachfront structures will remain vulnerable to hurricanes and other destructive storm events. As a result, property owners along the coast have a compelling interest in having an alternative means of protecting their homes and businesses from erosion.

Section 161, Florida Statutes (FS), and Chapter 62B-33, Florida Administrative Code (FAC), set forth the rules and regulations governing the issuance of permits for

shoreline protection activities along Florida's coastline. The Florida Department of Environmental Protection (FDEP), Office of Beaches and Coastal Systems, is the State agency that oversees this activity. Only structures built prior to the State's current rules regulating coastal development are eligible for the permanent installation of seawalls, revetments and other "armoring" structures. Structures built subsequent to the establishment of the State's Coastal Construction Control Line (CCCL) Rule and its attendant policies (i.e., structures built under a permit issued by FDEP pursuant to Section 161.052 or 161.053, FS, on or after March 17, 1985) are ineligible for such structures. That is because new construction must be designed, sited, and constructed in a manner that considerably reduces its vulnerability to erosion during storm events. Only structures determined to be "eligible" and "vulnerable" as defined by Chapter 62B-33, FAC, may receive permits from FDEP to construct permanent shoreline protection structures.

If erosion resulting from a major storm event (e.g., hurricane, tropical storm, northeaster, etc.) threatens private structures or public infrastructure, and a permit for shoreline protection has not already been issued by FDEP, a political subdivision of the State may authorize its citizens to implement temporary protection measures. Indian River County was the first county in Florida to acquire local emergency permitting authority under Chapter 161, FS. This allows issuance of permits for the protection of eligible and vulnerable private structures on County Beaches following any storm event for which an official declaration of emergency has been issued by the State or County. However, the County does not have unbridled authority to issue permits for any type of activity requested by property owners. In accordance with State law, the County must consider the potential effects of an emergency response on the beach-dune system, sea turtle habitat, and native coastal vegetation. Potential impacts to adjacent properties and preservation of public beach access must also be factored into the permitting decision. If structures are placed on the beach, they must be properly sited and designed, and they must be temporary.

IRC issued its first emergency permit in 1996. A total of six (6) emergency permits, encompassing 20 upland structures have been issued since then. Although the permits issued by Indian River County only allow for the implementation of temporary shoreline protection measures, permittees have the right to petition FDEP to erect permanent structures on their property. Four (4) of the emergency permits (protecting 13 structures) issued by the County ultimately resulted in permanent structures on the beach. FDEP permits for permanent structures for the remaining seven (7) structures are pending the outcome of the County's application for an ITP, as discussed below. Currently, IRC has approximately 5,711 linear feet of permanently armored shoreline, 1,675 ft (29.3 percent) of which was constructed under emergency authorization from the County.

In 1998, FDEP contended that certain erosion control structures built under emergency authorization from IRC had been placed farther seaward of the CCCL than allowed by State rules and regulations governing such structures and that these structures were likely to cause the "take" of sea turtles. The Caribbean Conservation Corporation (CCC), a non-profit environmental advocacy group, similarly believed that the issuance

of emergency permits by the County would cause take. They also noted that the structures were (a) not constructed within 60 days of the erosion event and (b) were not intended to be temporary, as required by State rules and regulations. The property owners whose homes were protected by the emergency structures (hereafter, the Summerplace and Gerstner Petitioners) requested that FDEP issue permits to allow the "temporary" structures to be reinforced as permanent structures at their existing locations, a request initially denied by FDEP.

In response to the increasingly litigious nature of this debate, FDEP, CCC, IRC, and the Summerplace and Gerstner Petitioners entered into a mutual covenant. An Interim Agreement (IA; Appendix A of the HCP) negotiated by all parties on March 23, 1999, required the County to develop a HCP and apply for an ITP. It also allowed the Summerplace and Gerstner Petitioners to retain their temporary structures pending the outcome of the ITP application. A companion Memorandum of Agreement (MOA; Appendix B of the HCP) entered into between FDEP and Indian River County set forth procedures that the County was required to follow when issuing emergency shoreline protection permits prior to obtaining an ITP. The IA and MOA constrained all parties from pursuing further legal action while IRC prepared an HCP and applied for an ITP.

Pursuant to the Interim Agreement described above, the Applicant is seeking an ITP that would authorize the take of the following species of sea turtles within the Plan Area (see definition below):

- Loggerhead turtles (*Caretta caretta*) – Loggerheads are the most common species of sea turtle to nest on IRC beaches and are listed under the Act as threatened.

- Green (*Chelonia mydas*) and leatherback (*Dermochelys coriacea*) turtles – Both species are federally listed as endangered. Although they nest regularly on County Beaches, they do so in substantially lower numbers than loggerhead turtles.

- Hawksbill (*Eretmochelys imbricata*) and Kemp's ridley (*Lepidochelys kempii*) turtles – These species are also federally listed as endangered. Although, both have occasionally nested on Florida's Atlantic coast beaches, neither has been documented in IRC.

Plan Area - For the purpose of this ITP, the Plan Area includes the entire Atlantic coastline of IRC between the Brevard and St. Lucie County Lines. The eastern and western limits of the Plan Area are the mean low water (MLW) line of the Atlantic Ocean and Highway A1A, respectively. The Applicant is requesting an ITP that would cover the take of sea turtles within the Plan Area over the 30-year life of the County's existing Beach Preservation Plan.

1.2 Purpose of the Proposed Action

The primary purpose of the proposed action is to authorize "take" of sea turtles within the Plan Area incidental to the otherwise lawful activities associated with future shoreline protection measures initiated under emergency authorization from Indian River County. Specific activities associated with future shoreline protection projects initiated under the County's emergency authorization for which the County seeks coverage for take include:

- Construction-related impacts to sea turtle nests, adults, and/or hatchlings during the implementation of shoreline protection measures under an Emergency Permit issued by IRC;
- Movement induced mortality and sub-lethal impacts to sea turtle eggs resulting from their relocation from construction areas during implementation of shoreline protection measures under an Emergency Permit issued by IRC;
- Direct impacts to sea turtle nests, adults, and/or hatchlings as the result of physical interaction with temporary shoreline protection structures installed under an Emergency Permit issued by IRC;
- Indirect impacts to sea turtle nests, adults, and/or hatchlings related to physical changes in beach conditions resulting from the presence of temporary shoreline protection structures installed under an Emergency Permit issued by IRC. Changes in beach conditions may include, but are not limited to, changes in beach profile, elevation, increased incidence of wave overwash, reflection and scour, compaction and sediment moisture content. Changes in these conditions may reduce nesting success (percentage of crawls resulting in nests) and/or reproductive success (percentage of eggs that produce hatchlings which emerge from the nest);
- Construction-related impacts to sea turtle nests, adults, and hatchlings during the removal of temporary shoreline protection structures installed under an Emergency Permit issued by IRC;
- Construction-related impacts to sea turtle nests, adults, and/or hatchlings during the installation of permanent shoreline protection structures installed under a permit issued by FDEP when the permanent structure replaces temporary measures initiated under an Emergency Permit issued by IRC;
- Direct impacts to sea turtle nests, adults, and/or hatchlings as the result of physical interaction with permanent shoreline protection structures installed under a permit issued by FDEP when the permanent structure replaces temporary measures initiated under an Emergency Permit issued by IRC; and
- Indirect impacts to sea turtle nests, adults, and/or hatchlings related to physical changes in beach conditions resulting from the presence of permanent shoreline protection structures installed under a permit issued by FDEP when the permanent structure replaces temporary measures initiated under an Emergency Permit issued by IRC.

In addition to future actions associated with emergency shoreline protection, the County is also requesting take for the retention of two "temporary" structures previously installed along the properties of the Summerplace and Gerstner Petitioners. Upon issuance of an ITP by the Service, the Petitioners would be allowed to retain their temporary structures

as permanent structures at their current locations or implement alternative protection in accordance with the terms and conditions of the ITP, the HCP, and the previously referenced Interim Agreement. Take associated with this action includes:

- Construction-related impacts to sea turtle nests, adults, and hatchlings during the removal of the temporary shoreline protection structures and/or installation of permanent armoring installed under a permit issued by FDEP;
- Direct post-construction impacts to sea turtle nests, adults, and/or hatchlings as the result of physical interaction with the permanent shoreline protection structures installed under a permit issued by FDEP; and
- Indirect impacts to sea turtle nests, adults, and/or hatchlings related to physical changes in beach conditions resulting from the presence of the permanent shoreline protection structures installed under a permit issued by FDEP.

The Applicant is not seeking authorization for take caused by temporary or permanent shoreline protection structures permitted by Indian River County and/or FDEP prior to issuance of this ITP or by future structures erected under FDEP's non-emergency permitting rules, as described in Section 161, Florida Statutes (FS), and Chapter 62B-33, Florida Administrative Code (FAC). However, take resulting from permanent structures permitted by FDEP as the result of measures initiated under the County's emergency authorization shall be authorized in accordance with the terms and conditions set forth in the ITP.

Service issuance of an ITP must be accomplished within the statutory and regulatory framework identified in Section 10 of the ESA and its implementing regulations found in Title 50 Code of Federal Regulations § 17. Preparation of this Environmental Assessment (EA) fulfills, in part, requirements of the National Environmental Policy Act (NEPA).

1.3 Need for the Proposed Action

The placement of seawalls, revetments and other protective structures as well as the undertaking of other erosion control measures within the nesting habitat of sea turtles may cause "take". Take, as defined in the ESA, means "to harass, harm, pursue, hunt, shoot, kill, wound, trap, capture, or collect, or attempt to engage in any such conduct." Under Title 50 Code of Federal Regulations § 17.3, "harm" is defined as "significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering." "Harassment" is defined as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering."

The beaches of IRC are recognized as important nesting habitat for sea turtles (Dodd 1978). Wabasso Beach has been deemed critically important for loggerhead

turtles, and some of the highest concentrations of green turtle nesting in the State occur in the Archie Carr National Wildlife Refuge (ACNWR) in Brevard and Indian River Counties (Meylan *et al.* 1995). Using best available data, it is estimated that an average of 251.8 loggerhead, 13.5 green, and 0.8 leatherback nests are deposited annually along each mile of beach in IRC (Table 1). This equates to approximately 5,603 loggerhead, 300 green, and 18 leatherback nests per year for the entire 22.25 miles of County shoreline.

Table 1
Sea Turtle Nest Densities Along Indian River County Beaches

Survey Area	Length (miles)	Average Number of Nests Per Mile		
		Loggerhead	Green	Leatherback
Sebastian Inlet State Recreation Area	2.03	368.6	10.3	0.2
Wabasso Beach North	2.44	573.3	15.4	0.3
Wabasso Beach Middle	2.60	319.5	20.4	0.9
Wabasso Beach South	0.77	212.2	7.4	0.7
Baytree, Sea Oaks, & Surrounding Areas	5.98	276.3	27.1	1.5
Vero Beach	4.21	97.0	3.0	0.4
Unsurveyed[1]	0.72	95.9	2.5	0.6
South County Beaches	3.50	94.7	2.0	0.8
All County Beaches	**22.25**	**251.8**	**13.5**	**0.8**

[1] Nest numbers are the average for Vero Beach and South County Beaches.

The activities involved in the emergency protection of vulnerable structures may include:

- Placing beach-compatible sand from upland sources on the beach;
- Creating a temporary barrier seaward of the structure using sand bags and/or geo-textile (fabric) tubes filled with sand;
- Shoring up (reinforcing) foundations; and
- Installing temporary wooden retaining walls, cantilever sheetpile walls (without concrete caps, tie backs, or other reinforcement), or similar structures seaward of the vulnerable structure.

Any of the activities identified above can potentially cause the take of sea turtles if conducted during the nesting season. The nesting season, the inclusive period during which adult turtles are coming ashore to nest and hatchling sea turtles are emerging from their nests to enter the sea, is established by the Florida Fish and Wildlife Conservation Commission (FWC) and is based on long-term, Statewide data. In Indian River County, the nesting season is defined by FWC as March 1 through October 31.

Take of sea turtles can occur both during and following implementation of shoreline protection measures (Table 2). During construction, incubating eggs in unmarked or missed turtle nests may be crushed, smothered, unearthed or otherwise damaged. Vibrations and water runoff from jetting operations during installation of structures can damage nests. Nests relocated from the construction area may suffer movement-induced mortality if not properly handled. Equipment and materials left on the beach overnight may effectively eliminate, or prevent nesting adults from reaching, otherwise suitable nesting habitat. Those same materials, as well as holes, ruts and construction debris on the beach, may entrap both adult and hatchling turtles. Removal of temporary structures following an erosion event may induce impacts similar to those occurring during initial construction.

Once a structure is in place, it can continue to cause problems for sea turtles (FWC, unpublished data). For example, hatchlings have been trapped in holes or crevices of exposed riprap and geotextile tubes. Both nesting turtles and hatchlings have been entangled or entrapped in the debris of failed structures. There have also been reports of injuries to nesting turtles that have been able to climb onto a seawall via adjacent properties and have subsequently fallen off.

Beaches seaward of seawalls and other armoring structures are typically narrower than natural unarmored beaches (Pilkey and Wright 1988). On eroding shorelines, poorly designed and sited seawalls may increase swash velocity, duration and elevation, thereby accelerating erosion in front of the structure (Plant and Griggs 1992, Terchunian 1988). Additionally, buried portions of a seawall may alter beach porosity, permeability, beach groundwater elevation, and beach slope variability. Collectively, these changes in beach characteristics can diminish the quality of the beach as nesting habitat for sea turtles. If temporary structures built under emergency authorization subsequently receive FDEP approval, they may become permanent fixtures on the beach, potentially contributing to reduced nesting and reproductive success for extended periods.

As the extent of armoring on beaches increases, the probability of a nesting turtle encountering a seawall or depositing a nest in sub-optimal habitat increases. Additionally, the displacement of nests from armored locations may increase the density of nests in a dwindling number of suitable nesting sites thereby increasing the potential for density-dependant nest mortality (e.g., turtles digging up existing nests).

Collectively, the impacts noted above harm and harass sea turtles and, therefore, constitute take, a prohibited act under Section 9 of the ESA. However, incidental take may be authorized under Section 10(a)(1)(B) of the Act to accommodate otherwise legal activities while conserving the affected species. To that end the Applicant is seeking an ITP from the Service. The Service is bound by the Act to respond to all applications for such requests.

Table 2
Potential Impacts of Shoreline Protection Activities on Sea Turtles

LIFE HISTORY STAGE	PERIOD OF IMPACT	POTENTIAL IMPACT
Eggs	Construction	Eggs may be crushed, unearthed or otherwise destroyed during construction activities (e.g., heavy equipment, excavation, pile driving, water jetting, etc.).
		Eggs may be buried beneath sand placed on the beach, resulting in mortality of developing embryos.
		Developing embryos may suffer movement-induced mortality during relocation.
	Post Construction	Eggs may be deposited in sub-optimum incubation environment. Nests deposited at lower elevations on the beach are more likely to suffer detrimental effects from tidal inundation.
Hatchlings	Construction	Hatchlings may be trapped beneath equipment, supplies and/or construction debris on the beach.
		If large quantities of sand are placed over incubating nests, hatchlings may not be able to escape from the nest.
		The migration of hatchlings to the ocean may be impeded by equipment/supplies on the beach. Holes and ruts left on the beach by construction activities may trap or misdirect hatchlings, increasing energy expenditures and susceptibility to predation.
		Construction lighting may disorient hatchlings.
	Post Construction	Holes, crevices, and deteriorating materials associated with structures composed of riprap, sand bags and geotextile tubes may trap or entangle hatchlings.
Nesting Females	Construction	Construction lighting and/or construction activities may deter nesting females from emerging onto the beach and reduce nesting success.
		Females may become entangled or trapped in building equipment and materials while searching for a nest site.
		Disturbed soil and holes left overnight in the construction areas may trap or topple nesting females.
	Post Construction	Fewer nesting females may emerge on beaches fronted by seawalls.
		Nesting success of turtles emerging on beaches fronted by seawalls may be reduced.
		Adult females contacting armoring structures in search of nesting sites may engage in increased wandering, which may increase overall energy expenditures.
		If sand and dunes build up along the sides of a seawall (e.g., along the tie-back) nesting turtles may be able to crawl onto or behind the structure. Injuries have been reported for turtles that fall off these walls while trying to return to the ocean (FWC unpublished data).

An HCP was submitted as part of Indian River County's ITP application. The HCP is a statutory component of the permit application and estimates the level or extent of incidental take likely to occur as a result of the proposed action. It also specifies how take will be minimized, and mitigated to the maximum extent practicable. The goal of the HCP is to improve the overall protection of sea turtles and their nesting habitat to such an extent as to offset any impacts resulting from shoreline protection measures initiated under the County's emergency authorization.

With respect to its review of Indian River County's ITP application, the needs and goals of the Service are to:

- Conserve sea turtles and their habitat by authorizing an ITP for the proposed action, as long as such authorization is not likely to appreciably reduce the likelihood of a listed species' survival and recovery in the wild; and
- Ensure compliance with Sections 7, 9, and 10 of the ESA, NEPA, and other applicable Federal laws and regulations.

1.4 Decision That Must be Made

The Service must decide whether to issue or deny an ITP. If the ITP evaluation criteria (see Part 1.5 below) set forth in Section 10(a)(2)(B) of the Act are satisfied, the Service is mandated to issue an ITP to the Applicant. Within these guidelines, the Service may decide to issue a permit conditioned on implementation of the HCP, as submitted by the Applicant, or to issue a permit conditioned on implementation of the HCP, as submitted, together with other measures specified by the Service. If the Act's criteria are not satisfied, the Service is required to deny the permit request.

1.5 Issues and Concerns

Beachfront property owners in Indian River County have a compelling interest in protecting their homes and businesses from threat of loss or damage due to coastal erosion. The State of Florida has established rules and procedures regulating shoreline protection activities and has delegated authority for issuing emergency permits for such activities to Indian River County. The County has assumed this authority because it feels it can provide its citizens with a more timely and effective response to emergency situations following major storm events. Although well intended, these activities nevertheless have the potential to cause take of federally protected species.

In evaluating the HCP developed in support of Indian River County's ITP application, the Service must primarily consider the issues listed below:

1. Will issuance of the ITP appreciably reduce the likelihood of survival or recovery of loggerhead, green, leatherback, hawksbill, or Kemp's ridley turtles in the wild?

2. Would the HCP, as submitted, minimize and mitigate take to the maximum extent practicable?
3. What alternative actions to the taking did the Applicant consider, and why were those alternatives rejected?
4. Would issuance of an ITP result in significant adverse impacts to other physical, cultural, or biological resources in the project area?
5. Is the proposed take incidental to an otherwise lawful activity?
6. Has the Applicant ensured that adequate funding will be dedicated to ensure implementation of the programs and measures proposed in the submitted HCP?
7. Are there other measures that should be required as a condition of the ITP?

1.6 Coordination and Consultation

USFWS personnel at the South Florida Field Office, Vero Beach, Florida, received and reviewed the ITP application in consultation with the Service's National Sea Turtle Coordinator in the Jacksonville, Florida Field Office. USFWS staff in the Atlanta, Georgia Regional Office were also consulted and participated in evaluation of key issues related to ESA and NEPA regulations. Additionally, the Office of the Solicitor of the Department of Interior reviewed the proposed Memorandum of Agreement between Indian River County and FDEP (Appendix F of the Applicant's HCP) and provided comments to the USFWS Regional Office. Based on that review, the Regional Office concluded that the MOA will satisfactorily unite Indian River County and State of Florida armoring permitting processes (Attachment A).

The FWC, the agency tasked with the monitoring, protection and recovery of protected species in Florida, provided input on the potential effects of armoring and other shoreline protection activities on sea turtles. FDEP was consulted on issues related to the permitting of emergency shoreline protection activities. The Florida Department of State, Division of Historical Resources, provided an assessment as to the effects emergency shoreline protection measures might have on historical standing structures and archaeological resources within the Plan Area (Attachment B).

USFWS worked closely with Indian River County and its consultant, Ecological Associates, Inc. (EAI) of Jensen Beach, Florida during development of the ITP application to ensure conformance to ESA and NEPA requirements. Additionally, staff of the Service's South Florida Field Office participated in several stakeholder meetings conducted by Indian River County during formulation of the HCP. Attendees included IRC, EAI, FDEP, FWC, CCC, and representatives of the Summerplace and Gerstner Petitioners. These meetings provided participants a perspective of the Service's needs and requirements under NEPA and the ESA and, thereby, helped frame work products developed and submitted in support of the ITP application. Minimization and mitigation measures contained in the HCP were developed by Indian River County under the guidance of Service staff and were based, in part, on stakeholder input. Additionally, copies of the draft HCP were distributed to the principal stakeholders for review and comment prior to submission of the ITP application to the Service.

2.0 ALTERNATIVES, INCLUDING THE PROPOSED ACTION

The Service is presented with two basic options relative to the Applicant's request for an ITP. It can either deny (No Action Alternative) or issue (Action Alternative) an ITP for the proposed action. However, to comply with NEPA, the Service is required to consider a full range of reasonable alternatives for addressing and responding to major public issues, management concerns, and resource conservation opportunities associated with emergency shoreline protection in Indian River County. The Applicant presented three alternatives to the proposed action in the HCP. In determining whether these alternatives provided a satisfactory range of options, the Service evaluated the following information:

- Social, economic, environmental and other relevant issues and concerns identified during both internal and public review of the proposal to issue an ITP;
- Biological requirements of sea turtles and other protected fauna and flora potentially affected by issuance of a Permit;
- The legal mandates of the Service under NEPA and the ESA; and
- The concerns of the Applicant.

Based on the above criteria, the Service considered one of the Applicant's Action Alternatives (see Section 2.5 for rejected alternatives). The Service also considered two additional Action Alternatives (Issuance of the ITP Independent of Other County Measures to Combat Shoreline Erosion and Issuance of the ITP Under Conditions Less Favorable to Permanent Beach Armoring) that it believes are needed to provide a full and reasonable range of alternatives to address identified needs and concerns.

2.1 Alternative 1: The No Action Alternative

Under this alternative (non-issuance of an ITP), IRC has two options: relinquish local emergency permitting authority or continue to issue emergency shoreline protection permits without the benefit of protection from take as afforded under Section 10 of the ESA. Continued issuance of emergency permits in the absence of an ITP places the County at risk of penalty under Federal law. Although shoreline protection activities could still be sanctioned through the State of Florida's standard permitting process, the elimination of local permitting authority could potentially delay a timely response to emergency situations and thereby increase the vulnerability of eligible structures to storm-related damage. In the absence of local authorization to respond to emergencies, the extent of damage to habitable structures might increase. This could lead to legal challenges from property owners, loss of beachfront property, a reduction in tax revenues, and impacts to historic and cultural resources and/or public infrastructure.

Should the County relinquish its emergency permitting authority, the State of Florida could resume issuance of emergency permits with or without Section 10 ESA protection for take. The State believes that current rules and regulations regarding

emergency permitting have been constructed to prevent the take of sea turtles. However, in addition to the temporary measures associated with emergency permitting, the Applicant has requested authorization for take resulting from the subsequent State permitting of permanent structures at those sites where emergency measures were initiated under County authorization. The Service considers that permanent shoreline armoring structures diminish the functional value of available nesting habitat and therefore cause take, as defined under the ESA. In the context of these longer-term impacts, it is not known what measures might be implemented by the State to minimize and mitigate take. However, for the purposes of this EA, it is assumed that protective measures would be essentially the same as those described under the Preferred Alternative.

Regardless of whether the State reassumes emergency permitting authority or the County continues to issue emergency permits in the absence of an ITP, take, as described under the following action alternatives, is likely to continue. Furthermore, the Applicant intends to proceed with implementation of its BPP, irrespective of the Service's decision to issue or not to issue an ITP. As described below under the Preferred Alternative, implementation of the BPP will reduce the need for future emergency shoreline protection measures. Thus, under the No Action Alternative (assuming that issuance of emergency shoreline protection permits will continue), impacts to sea turtles and other protected fauna and flora would be identical to those described under the action alternatives, but without the benefit of the minimization and mitigation measures proposed by the Applicant in the HCP.

2.2 Alternative 2: Issuance of the ITP in Conjunction With Shoreline Protection Measures Contained in IRC's Beach Management Plan (The Preferred Alternative)

The preferred alternative is Service issuance of a Section 10(a)(1)(B) permit to allow for the take of sea turtles incidental to shoreline protection activities initiated under the Applicant's emergency authorization. As summarized in Table 2, the proposed action may impact sea turtles both directly and indirectly. Some of these impacts (e.g., nest displacement) can be reasonably quantified, while others (e.g., effects of increased energy expenditures of nesting adults on total annual egg production) cannot. For this reason, the Service has expressed take as both the linear feet of shoreline armored (i.e., amount of habitat negatively impacted) and the estimated number of individual sea turtle units (i.e., adults, eggs, and hatchlings) harmed. In the analyses that follow, estimates of the latter form of take are expressed as nest equivalents. Insofar as the Applicant and Service have used conservative numbers in estimating take, it is assumed that the maximum extent of shoreline armoring authorized under the ITP will be reached before the authorized take of individual sea turtle units occurs. However, the Applicant will not be authorized to exceed either form of take regardless of which occurs first.

The ITP would authorize take for not more than 3,196 linear feet of shoreline permanently armored as the result of actions initiated under the Applicant's emergency authorization. Although the Applicant's planned beach nourishment projects will likely

reduce the need for future shoreline armoring, they will have no effect on the total amount of take authorized under the permit (i.e., a beach nourishment project built adjacent to an armoring structure installed pursuant to the terms and conditions of the permit and HCP will not free up an equivalent length of beach for armoring elsewhere in the Plan Area).

The ITP would be effective for the thirty-year period during which the County implements its current Beach Preservation Plan. The Applicant has developed measures to minimize take as much as practicable and would commit to mitigation measures commensurate with the level or extent of take resulting from the proposed action. This alternative provides conservation benefits to sea turtles while accommodating the otherwise lawful activity of emergency shoreline protection.

Emergency shoreline protection may involve a variety of measures that have different potentials for impacting sea turtles. These range from the placement of beach-compatible fill on the beach/dune system to erection of rigid structures (e.g., retaining walls). Although shoreline protection measures initiated under emergency authorization are intended to be temporary, they can lead to permanent structures on the beach. Thus, just as the severity of impacts may differ among project areas, the temporal scale of impacts may also vary.

As described in Section 1.3, Need for the Proposed Action, take of sea turtles can occur both during and following implementation of emergency shoreline protection measures. Impacts can be direct or indirect and can affect sea turtle eggs, adults, and/or hatchlings (Table 2). Those that occur during construction are usually temporary, relatively limited in scope, and can be effectively minimized. Those related to the presence of temporary emergency structures following construction are similarly limited in scale. However, if permanent structures result from measures initiated under emergency authorization, longer-term and substantially greater impacts may occur.

As noted above, the Service considers that permanent shoreline armoring structures diminish the functional value of available nesting habitat and therefore cause take, as defined under the ESA. The amount of take that will occur is directly related to the length of the structure and the inclusive period during which it affects nesting behavior and/or reproductive success. Presumably, impacts related solely to a structure's presence would cease once the affected beach/dune system is restored and maintained through beach nourishment or another type of habitat restoration project.

For the purpose of the analysis that follows, the Service assumed that all shoreline protection activities initiated under the County's emergency authorization would ultimately result in the construction of a permanent seawall or other type of state-approved armoring structure. This conservative approach ensures adequate accounting for take.

The Service believes that beachfront armoring eliminates nesting habitat, prevents turtles from accessing otherwise suitable nesting habitat landward of the structure, and/or

interferes with coastal processes that allow beaches to rebuild following an erosion event. However, empirical data are lacking to quantify these effects. Best available data indicate that on eroded beaches, such as those in Indian River County, the primary effect of permanent armoring structures is an overall reduction in nesting success seaward of the structures (Mosier 1998). For the purposes of the take analysis that follows, it is assumed that a turtle deterred from nesting by the presence of a structure will leave the site and nest elsewhere. Thus, nests are not necessarily lost to the parent population but, rather, are displaced to other locations. Nevertheless, time spent unsuccessfully searching for a suitable nesting site on armored beaches may exact some, as yet unquantified, cost to a turtle's total annual egg production. Furthermore, repeated encounters with seawalls may cause turtles to nest in sub-optimum environments.

The County plans to restore portions of its eroded coastline over the next 30 years through a series of beach nourishment projects (IRC 1998b). Beach restoration seaward of an armoring structure will generally serve to eliminate any reduction in nesting that might otherwise be attributable to the structure. Once a beach nourishment project is constructed, it will be maintained by placing additional sand on the beach at approximately 8-year intervals. Thus, nesting should only be reduced in front of a permanent structure from the time the structure is constructed until the time a beach nourishment project is initiated at that location. Presumably, emergency shoreline protection will not be required at any location where an active beach nourishment project is in place.

Beach profile data analyzed during preparation of the BPP and subsequent updates provided estimates of current erosion rates along County Beaches. This data was utilized by the Applicant to estimate take. It should be noted that although the County's proposed beach nourishment projects effectively serve to minimize the need for future emergency shoreline protection activities, beach nourishment is not proposed in the HCP as a minimization strategy. It has been used only as an end point in determining the length of time during which armoring structures are likely to cause take. Because beach nourishment alters natural shoreline conditions, it too can affect the sea turtle reproductive process (see Section 3.3.3.1.5, Beach Nourishment). Impacts associated with implementation of the County's BPP will be addressed during Federal permitting (U.S. Army Corps of Engineers) for each specific project.

Using measured erosion rates for various sections of the IRC coastline, the Applicant was able to predict the number of eligible structures likely to be vulnerable to storm-related erosion events. Using the dune erosion model prescribed by the State of Florida in Chapter 62B-33, FAC, recent beach profile and shoreline data for IRC were used to predict how close a structure must be to the dune escarpment to be considered vulnerable to impact from a 15-year return interval storm, the State's standard criteria for vulnerability. The model predicted that distance to be 19.5 ft. Once this number was determined, the crest of the dune along eroding sections of shoreline was located on recent (1999) scaled aerial photographs of the County. Average annual dune erosion rates were then utilized to project the extent of shoreline recession over various time intervals. Within each time interval evaluated, a structure was considered vulnerable

once the receding dune line moved to within 20 ft of the structure. This process was continued until the dune line was receded over the entire 30-year life of the County's BPP. Vulnerable structures determined in this manner might reasonably be expected to apply for an emergency shoreline protection permit from the County following a storm event that has been officially declared an emergency. A more thorough description of data and analytical methods used to conduct this assessment are presented in Appendix C of the Applicant's HCP.

Under Indian River County's current BPP schedule, 31 single and multi-family homes, encompassing 3,196 linear feet of shoreline, may be in need of shoreline protection prior to construction of a beach nourishment project at their respective locations (Table 3). Thirteen (13) of those structures will be protected upon completion of the first phase of the County's planned beach nourishment program scheduled for construction in 2002/2003. Another 12 structures would be protected after Phase II of the County's BPP is completed in 2004/2005. Only six (6) eligible structures projected to be vulnerable to erosion over the next 30 years are outside of any of the County's planned beach nourishment project areas.

The only available relevant data concerning the effects of armoring structures on sea turtle nesting was collected by Mosier (1998). She evaluated three sites in Brevard and Indian River Counties and compared loggerhead nesting on various sections of beach with and without seawalls. On average, nesting success (the percentage of all turtle crawls resulting in nests) was 69 percent lower at sites fronted by seawalls than at sites without seawalls. This value was applied to nesting data for all of Indian River County to determine how many nests (i.e. how much take) would be displaced as a result of activities proposed under the Preferred Alternative. It is estimated that seawalls built in front of the 31 properties vulnerable to erosion over the 30-year life of the County's BPP would result in a displacement of 1,150 loggerhead nests (Table 4). Assuming that similar reductions in nesting can be expected for other species, it was estimated that 56 green and 3 leatherback nests would also be displaced over the same 30-year period (Tables 5 and 6).

In addition to nest displacement, other forms of take may occur as the result of shoreline armoring installed under the Applicant's emergency authorization: adults, hatchlings and eggs may be harmed during construction activities, eggs may suffer movement-induced mortality during nest relocation, reproductive success may be reduced due to changes in the incubation environment, and nests may be more susceptible to tidal inundation and wash out (Table 2). Although acknowledging that these other forms of take are likely, the Applicant felt that they could not be reasonably quantified due to insufficient available data. Consequently, the Applicant's HCP only quantifies take resulting from nest displacement.

The Service reviewed available data and concurs that existing information is not available to estimate take of individual hatchling or adult sea turtles associated with construction activities. Similarly, available data are insufficient to quantify impacts to reproductive success related to physical changes in the nesting habitat seaward of

Table 3
Number and Location of Eligible Structures Potentially Vulnerable to Erosion in Relation to Indian River County's Planned Beach Nourishment Projects

SEA TURTLE SURVEY AREA	BEACH NOURISHMENT PROJECT AREAS	YEARS UNTIL PROJECT BEGINS	NUMBER OF VULNERABLE STRUCTURES PROTECTED BY BEACH NOURISHMENT		NUMBER OF VULNERABLE STRUCTURES UNPROTECTED BY BEACH NOURISHMENT		TOTAL NUMBR OF VULNERABLE STRUCTURES	
			Structures	Feet of Shoreline	Structures	Feet of Shoreline	Structures	Feet of Shoreline
SISRA	R 04 to R 17 (Phase I)[1]	2	0	0	0	0	0	0
Wabasso Beach North	R 04 to R 17 (Phase I)	2	5	318	1	120	6	438
Wabasso Beach Middle	R 37 to R 49 (Phase II)	4	4	368	5	541	9	909
Wabasso Beach South	R 37 to R 49 (Phase II)	4	6[2]	420	0	0	6	420
Baytree, Sea Oaks & Surrounding Areas	R 37 to R 49 (Phase II)	4	0	0	0	0	0	0

Table 3
(Continued)

SEA TURTLE SURVEY AREA	BEACH NOURISHMENT PROJECT AREAS	YEARS UNTIL PROJECT BEGINS	NUMBER OF VULNERABLE STRUCTURES PROTECTED BY BEACH NOURISHMENT		NUMBER OF VULNERABLE STRUCTURES UNPROTECTED BY BEACH NOURISHMENT		TOTAL NUMBER OF VULNERABLE STRUCTURES	
			Structures	Feet of Shoreline	Structures	Feet of Shoreline	Structures	Feet of Shoreline
Vero Beach	R 74 to R 86 (Phase II)[3]	4	2	385	0	0	2	385
Unsurveyed	No Project	NA	0	0	0	0	0	0
South County Beaches	R 100 to R 107 (Phase I)	2	8[4]	1,044	0	0	8	1,044
All County Beaches			**25**	**2,535**	**6**	**661**	**31**	**3,196**

[1] Phase I projects are scheduled to commence between 2002 and 2004.
[2] Properties (Summerplace Petitioners) where temporary shoreline protection structures are presently installed under the County's emergency authorization.
[3] Phase II projects are scheduled to commence in 2004 or later.
[4] Includes one property (100 ft; Gerstner Petitioner) where a temporary shoreline protection structure is presently installed under the County's emergency authorization.

armoring structures. However, the Service did quantify take resulting from destruction of unmarked nests during construction and mortality of eggs during nest relocation.

Construction of up to 31 emergency armoring structures during the 30-year permit period is expected to directly affect about 3,196 linear feet of nesting shoreline. Construction will likely be staggered throughout the 30-year permit period in response to coastal erosion events. Construction conducted during the nesting and hatching season could result in the loss of sea turtles by burial or crushing of eggs and/or hatchlings in nests. While a nest monitoring and egg relocation program would reduce these impacts, nests may be inadvertently missed (when crawls are obscured by rainfall, wind, and/or tides) or misidentified as false crawls during daily nesting surveys. Even under the best of conditions, about 7 percent of the nests can be misidentified as false crawls by experienced sea turtle nest surveyors (Schroeder 1994).

In estimating the number of unmarked nests potentially destroyed during construction of 31 armoring structures, the Service used average historical nesting densities for all of Indian River County (Table 1) and calculated the number of nests expected to be deposited annually per 100 linear feet of shoreline. The resultant value was then multiplied by 31.96, the number of 100-foot sections in the 3,196 linear feet of shoreline where structures may be installed. Finally, the product was multiplied by 0.07, the reported percentage of nests that may go undetected during surveys. For the purpose of this analysis it was assumed that all undetected nests would be impacted by construction. Thus, over the 30-year permit period, approximately 10.7 loggerhead and 0.6 green turtle nests would be adversely affected by construction activities associated with shoreline armoring initiated under the Applicant's emergency authorization; fewer than 0.1 leatherback nests would be affected.

There is also a potential for eggs to be damaged by their movement during relocation from construction areas, particularly if they are not relocated within 12 hours of deposition (Limpus *et al*. 1979). Nest relocation can have adverse impacts on incubation temperature (and hence sex ratios), gas exchange parameters, hydric environment of nests, hatching success (percentage of eggs in a nest that hatch), and hatchling emergence (Limpus *et al*. 1979, Ackerman 1980, Parmenter 1980, Spotila *et al*. 1983, McGehee 1990). Relocating nests into sands deficient in oxygen or moisture can result in mortality, morbidity, and reduced behavioral competence of hatchlings. Water availability is known to influence the incubation environment of the embryos and hatchlings of turtles with flexible-shelled eggs, which has been shown to affect nitrogen excretion (Packard *et al*. 1984), mobilization of calcium (Packard and Packard 1986), mobilization of yolk nutrients (Packard *et al*. 1985), hatchling size (Packard *et al*. 1981, McGehee 1990), energy reserves in the yolk at hatching (Packard *et al*. 1988), and locomotory ability of hatchlings (Miller *et al*. 1987).

Comparisons of hatching success between relocated and *in situ* nests have noted significant variation ranging from a 21 percent decrease to a 9 percent increase for relocated nests (Florida Department of Environmental Protection, unpublished data). Comparisons of emergence success (number of hatchlings successfully leaving the nest

expressed as a percentage of all eggs in the nest) between relocated and *in situ* nests have also noted significant variation ranging from a 23 percent decrease to a 5 percent increase for relocated nests (Florida Department of Environmental Protection, unpublished data).

A 1994 Florida Department of Environmental Protection study of hatching and emergence success of *in situ* and relocated nests at seven sites in Florida found that hatching success was lower for relocated nests in five of seven cases with an average decrease for all seven sites of 5.0 percent (range = 7.2 percent increase to 16.3 percent decrease). Emergence success was lower for relocated nests in all seven cases by an average of 11.7 percent (range = 3.6 to 23.36 percent; Meylan 1995).

Again, using historic countywide nesting densities and extrapolating to the 3,196 feet of shoreline potentially affected by emergency shoreline armoring, the Service projects that 152 loggerhead, 8 green, and 0.5 leatherback nests may be laid annually in construction areas. To determine movement-induced mortality of eggs during relocation, the Service assumes the following: (1) all armoring is constructed the first year of the permit, (2) one-half of all nests in construction areas will have to be relocated to avoid impacts, (3) the average loggerhead, green, and leatherback clutch contains 116 (Ehrhart and Witherington 1987), 132 (Johnson 1994), and 76 (Ecological Associates, Inc., unpublished data) eggs, respectively, and (4) mean emergence success for loggerhead, green, and leatherback nests is 63.6, 56.7, and 50.3 percent, respectively (same sources as for clutch size). Using the 11.7 percent reduction in emergence success resulting from nest relocation, it is estimated that 692 fewer hatchlings (656 loggerhead, 35 green, and 1 leatherback sea turtles) will emerge from relocated nests than would have if the nests were left *in situ*. Using the clutch size and emergence success data presented above, the average loggerhead, green, and leatherback nest produces 74, 75, and 38 hatchlings respectively. Thus, the loss of hatchling production due to nest relocation represents 8.9 loggerhead, 0.5 green, and less than 0.1 leatherback nest equivalents.

Collectively, take of sea turtles caused by construction, nest relocation, and nest displacement resulting from shoreline protection activities initiated under the Applicant's emergency authorization equals 1,169 loggerhead, 57 green, and 3 leatherback nests. At current nest densities, these figures represent less than one percent of all nests projected to be deposited on County Beaches over the 30-year life of the ITP (loggerhead = 0.7 percent, green turtles = 0.6 percent, and leatherbacks = 0.6 percent).

2.2.1 Minimization Measures

The Applicant has developed an HCP in support of the ITP application. The HCP contains measures to minimize impacts to sea turtles resulting from shoreline protection activities initiated under the County's emergency authorization. Short-term impacts can occur during implementation of emergency measures and/or during removal of temporary erosion control devices. Longer-term impacts can result if permanent armoring structures are allowed to replace temporary structures installed under emergency authorization.

2.2.1.1 Proactive Planning

The Applicant will develop a public awareness brochure that will be distributed to all beachfront property owners within the Plan Area advising them of the dynamic nature of the coastline and identifying areas of critical erosion. Owners of potentially vulnerable structures fronting critically eroded sections of beach will be encouraged to take appropriate action, as provided under Chapter 161, F.S., to ensure protection of their properties in advance of major storm activity. The brochure will contain contact numbers of County and State agencies that can provide technical guidance and assistance on shoreline protection issues. Information pertaining to sea turtle protection and nesting beach management issues affecting shoreline protection activities will also be presented, along with a schedule of planned beach nourishment projects. Finally, the brochure will contain procedures for applying for emergency permits.

2.2.1.2 Countywide Sea Turtle Monitoring Program

The biological goal of the HCP is to improve the overall productivity of the County's beaches as nesting habitat. To achieve this goal, the Applicant will first implement a comprehensive sea turtle monitoring program to document temporal and spatial nesting patterns and identify factors affecting nesting and reproductive success (e.g., artificial lighting, predation, erosion, etc.). Data from this program will be maintained in a Countywide database that can be used to effectively direct available resources to alleviate those conditions identified during monitoring as having the greatest adverse impact on hatchling productivity. To ensure complete and consistent coverage of the County's coastline, the Applicant will coordinate and standardize activities of existing sea turtle monitoring groups and expand monitoring into areas where no systematic program is currently in place. The Applicant will implement this Countywide program prior to issuance of any emergency permits for shoreline protection.

2.2.1.3 Declaration of Emergency

Under the HCP, no emergency shoreline protection permit (Emergency Permit) will be issued unless a storm that impacts County Beaches (the Plan Area) has been declared an emergency by State of Florida or the Board of County Commissioners of Indian River County, and the County's Coastal Engineer determines that beach erosion has occurred as a result of the declared emergency.

When an emergency or disaster has occurred or is imminent, the Emergency Management Director or his/her designee may activate the County's Comprehensive Emergency Management Plan. Activation of the Plan may be followed by a Declaration of Local Emergency as outlined in County Ordinance 91-18. In such case, the Emergency Management Director or his/her designee will draft a Resolution for the approval of the Board of County Commissioners. The Resolution describes the basis and conditions for declaring an emergency.

A Declaration of Local Emergency triggers communication and coordination between the Emergency Management Director and various County Departments. The

Superintendent of Public Schools is consulted to determine if schools should be closed. The Emergency Operations Center is opened and all emergency personnel must report in. Consequently, an emergency is declared only when truly hazardous conditions threaten. However, the declaration must be made sufficiently in advance of an approaching storm to allow for adequate evacuation and emergency preparations, if necessary. There have been three Declarations of Local Emergency in Indian River County during the past 10 years, all in response to named tropical storms.

2.2.1.4 Pre-Construction Assessments and Permitting

The County's Coastal Engineer will be responsible for reviewing requests for emergency shoreline protection permits, and will visit the site to assess a structure's eligibility and vulnerability to ensure that shoreline protection activities are only initiated where they are warranted. Based on site-specific conditions, the County's Coastal Engineer will recommend emergency shoreline protection measures commensurate with an eligible structure's degree of vulnerability. The protection measure(s) permitted shall have the least amount of adverse impact to sea turtles and their habitat as possible, while providing adequate protection to the vulnerable structure. "Soft" solutions, such as the placement of beach-compatible sand seaward of the structure or installation of sand bags, shall be utilized whenever possible. "Hard" solutions, such as wooden retaining walls, cantilever sheetpile walls, and similar structures will only be permitted when soft solutions cannot reasonably be expected to provide adequate protection for a vulnerable structure. The Applicant has prepared a guidance document entitled Rules and Regulations For Issuance of Emergency Permits For Shoreline Protection (Appendix E of the HCP) that describes the process that will be used to evaluate oceanfront structures to determine their eligibility for an emergency permit and assist in selecting the appropriate shoreline protection measure(s) for site-specific conditions.

Any structures or materials placed on the beach, including sand bags and sand-filled geotextile tubes, will be temporary in nature and will be designed and sited to facilitate their removal. These erosion control devices shall be sited as close as possible to the vulnerable structure to minimize the amount of nesting habitat affected. In no case may the shoreline protection structure be sited more than 20 feet seaward of the vulnerable structure. The precise location of the erosion control device shall be determined by the County's Coastal Engineer based upon the type of protective material(s) to be used, construction methods, site topography; distance between the vulnerable structure and the dune escarpment, extent of erosional threat to the vulnerable structure, presence/absence of sea turtle nesting habitat and/or marked nests, and other site-specific conditions. Erosion control devices shall be designed and positioned so they will not trap nesting or hatchling sea turtles or channelize upland runoff onto the beach where it might inundate or wash out nests.

Due to the extensive erosion typically associated with a storm that triggers an emergency declaration, it is unlikely that suitable nesting habitat would be present in the vicinity of a shoreline protection project initiated under the ITP. However, as part of the County's sea turtle monitoring program, monitoring personnel will routinely mark all nests at or landward of the toe of the dune along sections of beach designated by the State

Table 4
Estimate of Cumulative Loggerhead Turtle Nest Displacement
Over the 30-year Life of Indian River County's Beach Preservation Plan[1]

SEA TURTLE SURVEY AREA	YEARS UNTIL BEACH NOURISH-MENT	LINEAR FEET OF SHORELINE POTENTIALLY ARMORED UNDER THE ITP		NUMBER OF NESTS DISPLACED PRIOR TO PHASE I		NUMBER OF NESTS DISPLACED BETWEEN PHASE I AND PHASE II		NUMBER OF NESTS DISPLACED AFTER PHASE II		TOTAL NUMBER OF NESTS DISPLACED OVER 30 YEARS[3]
		Within Nourish-ment Zones	Outside Nourish-ment Zones	Per Year	Total	Per Year[2]	Total	Per Year	Total	
SISRA	2 (Phase I)	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wabasso Beach North	2 (Phase I)	318	120	32.9	65.8	9.0	18.0	9.0	234.0	317.8
Wabasso Beach Middle	2 (Phase II)	368	541	38.0	76.0	38.0	76.0	22.6	587.6	739.6
Wabasso Beach South	2 (Phase II)	420	0	11.7	23.4	11.7	23.4	0.0	0.0	46.8
Baytree, Sea Oaks & Surrounding Areas	2 (Phase II)	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vero Beach	4 (Phase II)	385	0	4.9	9.8	4.9	9.8	0.0	0.0	19.6

Table 4
(Continued)

SEA TURTLE SURVEY AREA	YEARS UNTIL BEACH NOURISH-MENT	LINEAR FEET OF SHORELINE POTENTIALLY ARMORED UNDER THE ITP		NUMBER OF NESTS DISPLACED PRIOR TO PHASE I		NUMBER OF NESTS DISPLACED BETWEEN PHASE I AND PHASE II		NUMBER OF NESTS DISPLACED AFTER PHASE II		TOTAL NUMBER OF NESTS DISPLACED OVER 30 YEARS[3]
		Within Nourish-ment Zones	Outside Nourish-ment Zones	Per Year	Total	Per Year[2]	Total	Per Year	Total	
Unsurveyed	NA	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South County Beaches	4 (Phase I)	1,044	0	13.0	26.0	0.0	0.0	0.0	0.0	26.0
All County Beaches		**2,535**	**661**	**100.5**	**201.0**	**63.6**	**127.2**	**31.6**	**821.6**	**1,149.8**

[1] This analysis assumes that all emergency shoreline protection measures result in the installation of permanent armoring structures during the first year that the ITP is in effect.

[2] For Phase I, calculated by multiplying the proportion of shoreline outside of the nourishment zones by the annual number of nests displaced prior to Phase I.

[3] Sum of nests displaced prior to Phase I, between Phase I and II, and after Phase II.

Table 5
Estimate of Cumulative Green Turtle Nest Displacement
Over the 30-year Life of Indian River County's Beach Preservation Plan[1]

SEA TURTLE SURVEY AREA	YEARS UNTIL BEACH NOURISH-MENT	LINEAR FEET OF SHORELINE POTENTIALLY ARMORED UNDER THE ITP		NUMBER OF NESTS DISPLACED PRIOR TO PHASE I		NUMBER OF NESTS DISPLACED BETWEEN PHASE I AND PHASE II		NUMBER OF NESTS DISPLACED AFTER PHASE II		TOTAL NUMBER OF NESTS DISPLACED OVER 30 YEARS[3]
		Within Nourish-ment Zones	Outside Nourish-ment Zones	Per Year	Total	Per Year[2]	Total	Per Year	Total	
SISRA	2 (Phase I)	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wabasso Beach North	2 (Phase I)	318	120	0.9	1.8	0.2	0.4	0.2	5.2	7.4
Wabasso Beach Middle	2 (Phase II)	368	541	2.4	4.8	2.4	4.8	1.4	36.4	46.0
Wabasso Beach South	2 (Phase II)	420	0	0.4	0.8	0.4	0.8	0.0	0.0	1.6
Baytree, Sea Oaks & Surrounding Areas	2 (Phase II)	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vero Beach	4 (Phase II)	385	0	0.1	0.2	0.1	0.2	0.0	0.0	0.4

Table 5
(Continued)

SEA TURTLE SURVEY AREA	YEARS UNTIL BEACH NOURISH-MENT	LINEAR FEET OF SHORELINE POTENTIALLY ARMORED UNDER THE ITP		NUMBER OF NESTS DISPLACED PRIOR TO PHASE I		NUMBER OF NESTS DISPLACED BETWEEN PHASE I AND PHASE II		NUMBER OF NESTS DISPLACED AFTER PHASE II		TOTAL NUMBER OF NESTS DISPLACED OVER 30 YEARS[3]
		Within Nourish-ment Zones	Outside Nourish-ment Zones	Per Year	Total	Per Year[2]	Total	Per Year	Total	
Unsurveyed	NA	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South County Beaches	4 (Phase I)	1,044	0	0.3	0.6	0.0	0.0	0.0	0.0	0.6
All County Beaches		**2,535**	**661**	**4.1**	**8.2**	**3.1**	**6.2**	**1.6**	**41.6**	**56.0**

[1] This analysis assumes that all emergency shoreline protection measures result in the installation of permanent armoring structures during the first year that the ITP is in effect.

[2] For Phase I, calculated by multiplying the proportion of shoreline outside of the nourishment zones by the annual number of nests displaced prior to Phase I.

[3] Sum of nests displaced prior to Phase I, between Phase I and II, and after Phase II.

Table 6
Estimate of Cumulative Leatherback Turtle Nest Displacement
Over the 30-year Life of Indian River County's Beach Preservation Plan[1]

SEA TURTLE SURVEY AREA	YEARS UNTIL BEACH NOURISH-MENT	LINEAR FEET OF SHORELINE POTENTIALLY ARMORED UNDER THE ITP		NUMBER OF NESTS DISPLACED PRIOR TO PHASE I		NUMBER OF NESTS DISPLACED BETWEEN PHASE I AND PHASE II		NUMBER OF NESTS DISPLACED AFTER PHASE II		TOTAL NUMBER OF NESTS DISPLACED OVER 30 YEARS[3]
		Within Nourish-ment Zones	Outside Nourish-ment Zones	Per Year	Total	Per Year[2]	Total	Per Year	Total	
SISRA	2 (Phase I)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wabasso Beach North	2 (Phase I)	318	120	0.02	0.04	0.01	0.02	0.01	0.26	0.32
Wabasso Beach Middle	2 (Phase II)	368	541	0.11	0.22	0.11	0.22	0.07	1.82	2.26
Wabasso Beach South	2 (Phase II)	420	0	0.04	0.08	0.04	0.08	0.00	0.00	0.16
Baytree, Sea Oaks & Surrounding Areas	2 (Phase II)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vero Beach	4 (Phase II)	385	0.00	0.02	0.04	0.00	0.00	0.00	0.00	0.04

Table 6
(Continued)

SEA TURTLE SURVEY AREA	YEARS UNTIL BEACH NOURISH-MENT	LINEAR FEET OF SHORELINE POTENTIALLY ARMORED UNDER THE ITP		NUMBER OF NESTS DISPLACED PRIOR TO PHASE I		NUMBER OF NESTS DISPLACED BETWEEN PHASE I AND PHASE II		NUMBER OF NESTS DISPLACED AFTER PHASE II		TOTAL NUMBER OF NESTS DISPLACED OVER 30 YEARS[3]
		Within Nourish-ment Zones	Outside Nourish-ment Zones	Per Year	Total	Per Year[2]	Total	Per Year	Total	
Unsurveyed	NA	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South County Beaches	4 (Phase I)	1,044	0	0.11	0.22	0.00	0.00	0.00	0.00	0.22
All County Beaches		**2,535**	**661**	**0.30**	**0.60**	**0.16**	**0.32**	**0.08**	**2.08**	**3.00**

[1] This analysis assumes that all emergency shoreline protection measures result in the installation of permanent armoring structures during the first year that the ITP is in effect.

[2] For Phase I, calculated by multiplying the proportion of shoreline outside of the nourishment zones by the annual number of nests displaced prior to Phase I.

[3] Sum of nests displaced prior to Phase I, between Phase I and II, and after Phase II.

of Florida as critically eroded. These nests shall be termed sentinel nests, and their location determined with a Global Positioning System (GPS) possessing sufficient precision as to allow the reestablishment of nest barriers should they be vandalized.

Prior to implementation of any emergency shoreline protection activities during the sea turtle nesting season (March 1 through October 31), FWC-permitted monitoring personnel will inspect the site of any property for which an Emergency Permit has been requested to assess nesting habitat suitability. The absence of sentinel nests at the site shall be indicative of the absence of viable nests. If sentinel nests are present, it is likely that erosion has been minimal and shoreline protection is not warranted. However, the presence of sentinel nests alone shall not preclude the Applicant from initiating emergency shoreline protection activities. Should marked nests be present at the site, and the Coastal Engineer determines that shoreline protection measures are warranted, he/she, in consultation with sea turtle monitoring personnel, will determine if the nest(s) can be safely left in place (*in situ*). Those that can will be marked in accordance with procedures established in the HCP.

If marked nests at the site of a proposed emergency shoreline protection project are likely to interfere with implementation of effective shoreline protection measures, the nests may be relocated from the project area. However, no nest relocation can occur until after an Emergency Permit is issued for the property. All activities associated with the relocation of eggs from a project shall be performed in accordance with the most current FWC guidelines, with the following exceptions:

- Nests can be relocated because of construction activities; and
- Sentinel nests can be moved at any time during their incubation period.

The pre-construction assessment of nesting habitat suitability and presence/absence of marked nests will be factored into the Coastal Engineer's decision as to the type of shoreline protection measures and/or the siting of temporary structures allowed under an Emergency Permit. To the greatest extent practicable, the Coastal Engineer will only allow those activities that will avoid impacts to marked nests while providing adequate temporary protection for the vulnerable structure.

2.2.1.5 Construction Precautions During the Nesting Season

If any construction activities are to occur on the beach during any portion of the sea turtle nesting season (March 1 through October 31), a sea turtle monitoring program must be in place for any areas of the beach potentially affected. The intent of construction-phase monitoring is to identify and protect any new nests that may be deposited in the project area during the period of construction and to ensure that marked nests, if present, are unaffected by construction activities. Daily monitoring shall commence on March 1 or the date of Emergency Permit issuance, whichever is later and shall continue uninterrupted until the completion of construction or September 30, whichever is earlier. If construction proceeds beyond September 30 and marked nests remain within the project area, daily monitoring will continue until the last marked nest has hatched.

Construction-phase monitoring shall include the following:

1. Daily sea turtle monitoring shall be performed at the construction site, the beach access point for construction equipment, and the beach corridor used by equipment to travel between the access point and construction site, as applicable. Based on the nature of authorized emergency measures and construction techniques, the Coastal Engineer may include a 25-foot buffer zone on either end of the construction site to allow for the maneuvering of equipment. The north and south boundaries of the inclusive area encompassing the construction site, buffer zone, access point, and travel corridor, as applicable, shall be considered the project area. The project area shall be conspicuously marked and monitored each day. No construction activity may commence until the survey is completed.

2. Nests deposited in the project area shall either be marked and avoided (if they will not be impacted by construction activities) or relocated in accordance with procedures established in the HCP.

3. If an unmarked sea turtle nest is encountered during the course of implementing shoreline protection measures, construction in the vicinity of the nest shall cease immediately and the sea turtle monitoring personnel shall be notified. Construction may not resume until the nest is relocated to a safe, sheltered location.

4. To the greatest extent practicable, construction shall be conducted from the upland portion of the property for which an Emergency Permit has been issued. No heavy equipment (e.g., tracked or wheeled motorized machinery, such as bobcats, bulldozers, front-end loaders, etc.) shall be operated on the beach, unless no reasonable upland alternative exists. If heavy equipment must be operated on the beach in support of a permitted emergency shoreline protection project, an access site as close to the construction site as possible will be selected by the County's Coastal Engineer in consultation with sea turtle monitoring personnel. A marked path no wider than 50 feet and running perpendicular to the beach from the dune to the high tide line will be used for beach access. Equipment ingress and egress shall be confined to this marked corridor. Once on the beach, equipment may only be moved to and from the construction site at low tide along the wetted portion of the beach (i.e. below the previous high tide line).

5. Construction shall be confined to daylight hours. No equipment or materials shall be left on the beach overnight, unless: (a) tidal conditions preclude reasonable daily movement of equipment between the construction site and the access point or (b) the storage of equipment on the beach at night poses less risk to sea turtles than the daily movement of equipment to and from the construction site.

6. If construction on the beach poses a hazard to turtles (e.g., large holes, trenches, etc.), those areas shall be effectively barricaded at night so turtles are not trapped or injured. These barricades shall be: (a) constructed of materials that will not entrap turtles, (b) the minimum length required to effectively prevent turtles from accessing the hazardous area, and (c) sited as close to the hazard as possible. This will minimize the amount of nesting habitat pre-empted by construction activities. FWC-permitted personnel shall monitor barricaded areas each morning prior to commencement of any construction activities to ensure that turtles have not breached the barricade.

2.2.1.6 Post-Construction Monitoring During the Nesting Season

Following construction, temporary structures installed under an Emergency Permit shall be closely inspected each day during the sea turtle nesting season to ensure that they do not trap or pose hazards to nesting or hatchling sea turtles. If hazards are identified, appropriate corrective measures shall be implemented.

The Applicant shall compile and analyze all sea turtle monitoring data collected at the construction site during the period from completion of construction through September 30, the date the last marked nest has hatched, or the temporary structure is removed from the beach, as applicable. This information will be used to assess the effects of the temporary structure on nesting and reproductive success.

2.2.1.7 Construction Precautions During Removal of Temporary Structures

Temporary shoreline protection structures, including sheetpile seawalls, wooden retaining walls, geotextile tubes, sand bag installations, and similar structures installed pursuant to an Emergency Permit from Indian River County, shall be removed within 60 days of their installation unless:

- A complete application for retention of the temporary structure or alternative protection has been submitted to FDEP; or
- Removal of the temporary structure is likely to impact sea turtle nests to a greater degree than the impact resulting from the structure remaining in place until the end of the nesting season, as determined by FWC in consultation with sea turtle monitoring personnel.

To minimize impacts to sea turtle nests, removal of temporary structures shall be in accordance with the following guidelines:

1. If the 60-day installation period expires between October 31 and March 1, removal of the temporary structure must be completed prior to March 1.
2. If the 60-day installation period expires between March 1 and May 1, the temporary structure must be removed prior to May 1 in conjunction with a sea turtle monitoring and nest protection program, as described for initial construction activities.

3. If the 60-day installation period expires between May 1 and October 31, the temporary structure will be removed after the last marked nest in the project area has hatched, unless the structure can be effectively removed without encroaching on any marked nests, as determined by the Coastal Engineer in consultation with sea turtle monitoring personnel. If existing or newly deposited nests impede structure removal activities, structure removal will cease until those nests have hatched.
4. Construction activities associated with the removal of temporary structures shall not exceed 20 days.
5. All debris and structural material, including tie downs and fabric from geotextile tubes, must be removed from the beach/dune area and deposited off site, landward of the CCCL.

To the greatest extent practicable, construction associated with the removal of temporary structures shall be conducted from the upland portion of the affected property. No heavy equipment (e.g., tracked or wheeled motorized machinery, such as bobcats, bulldozers, front-end loaders, etc.) shall be operated on the beach, unless no reasonable upland alternative exists, as determined by the Coastal Engineer. If heavy equipment must be operated on the beach to effectively remove a temporary structure, an access point as close to the construction site as possible will be selected by the County's Coastal Engineer. A marked path no wider than 50 feet and running perpendicular to the beach from the dune to the high tide line will be used for beach access. Equipment ingress and egress shall be confined to this marked corridor. This equipment may only be moved to and from the construction site at low tide along the wetted portion of the beach (i.e. below the previous high tide line).

Upon completion of construction activities, the Applicant will assess the condition of the beach/dune system within the project area. Any damage to the beach dune system resulting from authorized activities must be repaired to its pre-construction condition prior to the beginning of the next nesting season. All beach/dune restoration activities shall occur outside of the sea turtle nesting season.

2.2.2 Mitigation Measures

The Applicant has developed an HCP in support of the ITP application. The HCP contains measures to mitigate unavoidable impacts to sea turtles resulting from shoreline protection activities initiated under the County's emergency authorization. To evaluate the adequacy of proposed mitigation measures, it is first necessary to estimate the amount of take likely to occur as a result of activities authorized under the ITP.

As discussed in Section 1.3, Need for the Proposed Action, take of sea turtles can occur both during and following construction of emergency protection measures (Table 2). The extent of construction-related impacts is difficult to quantify because of inherent uncertainties as to the time of year the construction will occur (affects the likelihood of interaction with nesting females, nests, and/or hatchlings), the proximity of construction activities to sea turtle nests, and the location of equipment access sites. Generally though, take associated with construction is relatively limited, and it can be avoided to a

large extent through implementation of the minimization measures contained in the HCP. Nevertheless, a small number of nests may still be taken during construction activities.

The extent of take associated with the installation of permanent armoring structures is substantially greater than that related to construction. The Service considers that seawalls and similar structures diminish the functional value of available nesting habitat and, therefore, their presence on the beach may cause take over extended periods.

For the purpose of assessing mitigation, the Service took a conservative approach and assumed that every emergency shoreline protection permit it issues will result in the installation of a permanent armoring structure. Furthermore, it assumed that all of the emergency permits would be issued during the first year that the ITP is in effect. Thus, for the 13 structures that are in the first phase of the County's beach nourishment program, take was calculated over a two-year period – from the year the ITP is issued to the time of construction for the first beach nourishment project. During this period, it is estimated that 201 loggerhead nests would be displaced due to armoring (Table 4). In effect, it is unlikely that all 13 structures in the Phase I project area will request an emergency permit during the first year of ITP issuance, and it is possible that no permits are necessary if the County's beach nourishment project is constructed prior to the first declared emergency storm. Thus, if less conservative assumptions were applied to this analysis, take estimates could be reduced considerably. However, the Service feels that the over estimate of take resulting from this conservative approach is needed to adequately accommodate construction-related and other short-term impacts associated with implementation of temporary erosion control measures, because take associated with these impacts is very difficult to quantify.

Using the conservative approach described above, it is estimated that 1,150 loggerhead, 56 green, and 3 leatherback nests will be displaced due to the presence of armoring structures over the 30-year life of the requested ITP (Tables 4-6).

In assessing the benefits of proposed mitigation, the Service recognizes two categories of mitigation: those that can be quantified and those that intuitively have conservation benefit but do not result in a direct or immediate reduction of impacts. For example, the Applicant has proposed a comprehensive sea turtle monitoring program in Indian River County. This involves systematic monitoring of County Beaches not currently being surveyed, standardization of monitoring procedures among various sea turtle permit holders (persons authorized by FWC to conduct monitoring on County Beaches), and establishment of a Countywide sea turtle database. Although, this program will not result in a reduction in the number of turtles and/or nests impacted by various activities on or near the beach, it will provide the information needed to develop and implement programs that will. Additionally, the Applicant has proposed a proactive light management program for unincorporated areas of the County.

As it assessed the cost to benefit ratios of the Applicant's proposed action, the Service only considered mitigation that will result in direct quantifiable benefits to sea turtles. However, the Service encouraged the Applicant to implement the above-

referenced additional non-quantifiable conservation measures as part of an adaptive management strategy. Based on the benefits of these programs and through consultation with the Service, the Applicant could then modify its mitigation program to more accurately compensate for take associated with shoreline protection activities authorized under the ITP. Evaluation and/or modification of mitigation measures would occur after the first five (5) years that the ITP has been in effect and periodically thereafter, as required.

In calculating the benefits of quantifiable mitigation measures (public acquisition of sea turtle nesting habitat and predator control), best available scientific information was utilized. In those cases where available data were inadequate to fully support the analyses, certain assumptions were required. These assumptions are clearly identified.

2.2.2.1 Conservation Benefits Derived From Previous Public Acquisition of Environmentally Sensitive Lands

Between 1996 and 1998, Indian River County cost-shared (50 percent) in the purchase of several parcels of land through Florida's Conservation and Recreational Lands (CARL) program. The purchase price was approximately 13.2 million dollars. Collectively, the land encompasses 110 acres of barrier island habitat between the Indian River Lagoon and the Atlantic Ocean just north of the town of Indian River Shores. Seventeen (17) of these acres front the beach and comprise about 1,500 linear feet of shoreline. Although the State holds title to the land, the County is responsible for its management.

The CARL property was purchased and is managed primarily for conservation and passive recreation. The property includes maritime hammock and coastal strand vegetation, two sensitive and increasingly rare plant communities along Florida's east coast. The beach adjacent to the property supports some of the highest sea turtle nesting densities in Indian River County (approximately 305 nests/mile). On average, it is estimated that 78.5 loggerhead, 7.7 green, and 0.4 leatherback turtle nests per year are deposited on the beaches fronting the CARL property. The Federal recovery plans for both the Atlantic loggerhead and Atlantic green turtle (NMFS and USFWS 1991a and b) rank the acquisition of nesting beaches between Melbourne and Wabasso Beach, Florida as a number one priority. The CARL property lies within that section of coastline. A number one ranking in the recovery plan identifies "an action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future."

The purchase of the CARL property ensures that no private development can occur there, and thus it eliminates potential impacts to sea turtles associated with human habitation adjacent to nesting beaches. Public access is limited to one small parking lot and a single dune crossover, and access is limited to daylight hours only. The nearest adjacent public access is more than one mile away. There are no plans for expanding facilities at the park.

The CARL property is in an area zoned for single and multi-family (i.e., condominiums) residential development. If the property were fully developed, the two principal impacts to sea turtles would be human disturbances to nesting females and artificial lighting impacts to both nesting females and hatchlings. Based on available information, the Applicant estimated the amount of take associated with these impacts.

People residing on oceanfront property frequently walk on the beach at night. Many times this activity is undertaken specifically to observe nesting sea turtles. In a comparable area in south Brevard County, Johnson *et al*. (1996) encountered as many as 80 people a night on a 1.86-mile section of beach.

Turtles encountered on the beach at night prior to commencement of oviposition (egg laying) are easily frightened back into the ocean (Murphy 1985, Witherington 1992). Hailman and Elowson (1992) estimated that a loggerhead spends, on average, 66.7 minutes on the beach prior to, during, and following oviposition. Of that, 25.7 minutes (38.4 percent) are spent as the turtle ascends the beach and selects a nesting site. Johnson *et al*. (1996) arrived at a similar estimate (40.6 percent) for turtles on south Brevard County Beaches.

Sea turtle nesting occurs almost exclusively at night. During the nesting season in south Florida nightfall occurs around 9:00 PM and sunrise about 6:00 AM. Thus, turtles may be encountered over a 9-hour period. However, the majority of humans on the beach at night typically depart by midnight. Thus, assuming that nesting is evenly distributed throughout the night, the potential for human/turtle interactions is primarily limited to one third (3 out of 9 hours) of all emergences (crawls). At the CARL property, this equates to 25.9 loggerhead, 2.6 green, and an insignificant number of leatherback turtles per year. Assuming (arbitrarily) that one half of these turtles are intercepted by humans at some point during their nesting activity and that there is a 38.4 percent chance of encountering the turtle prior to oviposition (Hailman and Elowson's 1992 estimate), an average of 5.0 loggerhead turtles and 0.5 green turtles per year would be encountered prior to oviposition. Assuming human interaction, these turtles would in all likelihood abandon their nesting attempt and would deposit their eggs at another time and/or place. Thus, analogous to the effects of armoring structures, human encounters with sea turtles on the beach fronting the CARL property would result in the displacement of 150 loggerhead, 15 green, and less than one leatherback turtle nests over the 30-year life of the ITP.

In addition to substantially reducing the potential for human disturbances to sea turtles, the acquisition of the CARL property will eliminate the potential for lighting impacts along that stretch of beach. Artificial beachfront lighting deters adult female turtles from coming ashore to nest and interferes with the natural ability of hatchling sea turtles to properly orient to the ocean after leaving the nest (Witherington and Martin 2000). The survivorship of hatchlings deprived of a direct and timely nest to sea migration is reduced. Hatchlings drawn by artificial lighting into parking lots and onto roadways may be killed outright. Those that wander aimlessly on the beach are more

susceptible to predation, use up valuable energy reserves, and may succumb to heat exhaustion.

The Service is aware of no reliable empirical studies that quantify benefits of light management directly applicable to the Indian River County CARL property. However, a study performed in the City of Fort Pierce, in neighboring St. Lucie County, provides an illustrative example of the effects of artificial beachfront lighting. Ecological Associates, Inc. (EAI, unpublished data) marked every sea turtle nest deposited along a 1.3-mile section of renourished beach during the 2000 nesting season. This section of beach is fronted primarily by single- and multi-family residences, although a few small commercial establishments are present near the Ft. Pierce jetty were nesting activity is very low. Thus, the land use in that portion of the Ft. Pierce study area where most nesting occurs is similar to what might be expected on the CARL property if it were developed.

Even though Ft. Pierce has adopted beachfront lighting regulations, hatchlings from 34 of the 99 nests (34.3 percent) documented during 2000 were disoriented by artificial lights. The average number of hatchlings disoriented per nest was 20.4. At the similarly zoned CARL property, it is estimated that 78.5 loggerhead, 7.7 green, and 0.4 leatherback turtle nests are deposited annually. If the property were developed in a manner similar to Ft. Pierce and lighting affected hatchlings similarly, an average of 26.9 loggerhead, 2.6 green, and 0.15 leatherback turtle nests would be disoriented each year. Based on 20.4 hatchlings per disoriented nest, lighting would affect a total of 549 loggerhead, 53 green, and 3 leatherback turtle hatchlings.

Loggerhead nests in southern Brevard County have a mean clutch size of 116 eggs and an average emergence success (percentage of eggs that produce hatchlings which emerge from the nest) of 63.6 percent (Ehrhart and Witherington 1987). Thus, each nest produces, on average, 73.8 hatchlings. Therefore, the 549 disoriented loggerhead hatchlings potentially disoriented each year at the CARL property represent 7.4 nest equivalents. Projected over the 30-year life of the ITP, this equals 222 loggerhead nests.

Green turtles in southern Brevard County have an average clutch size of 132 eggs and an average emergence success of 56.7 percent (Johnson 1994). On Hutchinson Island, Florida, the average leatherback nest contains 75.7 yolked eggs, and the average emergence success is 50.3 percent (Ecological Associates, Inc., unpublished data). Applying the same analysis as was used above for loggerhead turtles, the 53 green and 3 leatherback turtle hatchlings potentially disoriented each year at the CARL property represent 0.7 and 0.1 nest equivalents, respectively. Thus, by extension, the acquisition and management of the CARL property will protect 21 green and 3 leatherback turtle nests from lighting impacts over the 30-year life of the ITP.

In a study conducted to assess the affects of artificial lighting on sea turtle nesting behavior, lights were placed near the beach and the numbers of nests deposited each night were compared between illuminated and adjacent dark sections of beach (Witherington

1992). Lights reduced nesting by 54.3 percent for loggerheads and 41.4 percent for green turtles. Thus, if the CARL property was developed in the absence of an effective light management program, it could result in a reduction of 42.6 loggerhead and 3.2 green turtle nests per year. Although no empirical data are available to assess lighting impacts on adult leatherbacks, effects are likely similar to those documented for the other two species. Using the most conservative of these (41.4 percent), lighting at the CARL property could result in a reduction of 0.2 leatherback nests per year. Thus, similar to the affects of armoring and human disturbance, as many as 1,278 loggerhead, 96 green, and 6 leatherback turtle nests could be displaced over the 30-year life of the ITP because of artificial lighting associated with the development of the CARL property.

The analysis presented above is based on best available information. However, it could be argued that the data pertaining to lighting effects on adult turtles is not directly applicable to a "traditional" residential setting, or that if the property were developed, some of the beachfront residents would comply with lighting regulations (thereby reducing lighting impacts), or that human disturbances on the beach would be less disruptive than estimated. In consideration of these factors, the Applicant has equitably reduced the estimated amount of benefits attributed to the CARL property by 50 percent.

2.2.2.2 Predator Control Program

Some of the highest nesting densities in Indian River County occur in the primarily undeveloped regions at the northern end of the County. Sea turtle reproductive success in natural areas is frequently reduced by a variety of animals that prey upon eggs and hatchlings. Raccoons, foxes, feral pigs and armadillos cause considerable damage to turtle nests in various areas of east central and south Florida (Ehrhart and Witherington 1987). Along a 5.8-mile section of beach (Wabasso Beach) south of the Sebastian Inlet State Recreation Area, including portions of the Archie Carr National Wildlife Refuge, predators destroyed 14.8 percent of all nests (all species combined) deposited during 1999 (Paul Tritaik, Manager, Pelican Island and ACNWR, unpublished data). Based on average nesting densities for Wabasso Beach, this equates to approximately 354.2 loggerhead, 14.3 green, and 0.5 leatherback turtle nests per year.

Successful predator control programs have been implemented in other wildlife refuges with moderate to high success. Trapping and selective culling of predators are the most effective methods. In the Hobe Sound National Wildlife Refuge and contiguous St. Lucie Inlet State Preserve in Martin County, Florida, predators partially or completely destroyed 48.4 percent of all sea turtle nests during 1998 (Engeman et. al In Preparation). Since then, a professional trapper, specifically targeting raccoons and armadillos responsible for raiding nests, reduced overall predation rates to 27.7 percent. Thus, an effective predator removal program reduced the number of nests destroyed between 1998 and 2000 by 42.8 percent.

If a comparable predator control program were implemented in the entire 5.8-mile extent of the Wabasso Beach area, an average of 151.6 loggerhead, 6.1 green, and 0.2 leatherback turtle nests might be saved each year. However, the Applicant's predator control program offered for mitigation cannot supplant a similar program planned for

federally managed lands within the Refuge. Within the 5.81-mile area, 0.60 miles, or about 10.3 percent, are managed by the federal government; the Applicant is legally responsible for managing the remaining public lands. Therefore, only 89.7 percent (non-federal lands) of the benefit can be applied. Nevertheless, over the 30-year life of the ITP, the Applicant's proposed predator control program will increase hatchling productivity by saving approximately 4,080 loggerhead, 165 green, and 6 leatherback turtle nests.

2.2.2.3 Cumulative Benefits

Collectively, the mitigation benefits identified above total 4,905 loggerhead, 231 green, and 11 leatherback turtle nests (Table 7). Thus, the County proposes to mitigate the destruction and/or displacement of turtle nests caused by emergency shoreline protection activities at the ratio of about 4:1 for both loggerhead and green turtles and 3.6:1 for leatherbacks. Considering that the estimates of nest displacement due to shoreline armoring are very conservative (i.e. all emergency permits will result in permanent armoring installations during the first year that the ITP is in effect), the mitigation described above should provide a net conservation benefit to sea turtles in Indian River County. Furthermore, 98 percent of the take being mitigated for is related to nest displacement, a non-lethal form of take, whereas the proposed mitigation measures largely reduce lethal take.

2.2.2.4 Other Conservation Measures

As indicated above, the Applicant has proposed additional measures that offer obvious conservation benefits, while not resulting in any direct or immediate reduction of impacts. These include a comprehensive sea turtle monitoring program and a proactive light management program in unincorporated areas of the County. Both will be implemented as part of the adaptive management strategy described in the HCP.

The Applicant will conduct and/or coordinate sea turtle monitoring throughout County Beaches. In those areas where monitoring is currently being performed by outside parties, the Applicant may simply coordinate monitoring efforts to ensure that the type of data needed to assess current natural and human-related impacts to sea turtles is systematically collected. In those areas where monitoring is not presently being performed, the County will implement a monitoring program utilizing personnel authorized by FWC to perform such activities. Depending on fiscal and political constraints, the Applicant may also elect, but is not required, to assume monitoring activities in areas currently being surveyed by other government or private entities. This would further promote standardization of data collection activities.

Table 7
Summary of Benefits, Expressed as Nest Equivalents, for Mitigation Measures Proposed by Indian River County to Offset Potential Impacts to Sea Turtles Related to Shoreline Protection Measures Initiated Under Emergency Authorization

Mitigation Effort	SPECIES		
	Loggerhead	Green	Leatherback
Reduce Potential for Human Interactions Through Acquisition of CARL Property[1]	75.0	7.5	0.4
Eliminate Lighting Impacts on Hatchlings Through Acquisition of CARL Property[1]	111.0	10.5	1.5
Eliminate Lighting Impacts on Nesting Turtles Through Acquisition of CARL Property[1]	639.0	48.0	3.0
Protect Nests Through Predator Control	4,080.0	165.0	6.0
TOTAL MITIGATION BENEFITS	**4,905.0**	**231.0**	**10.9**
Losses Associated With Federally Authorized Action			
Construction Impacts	10.7	0.6	0.0
Nest Relocation Impacts	8.9	0.5	0.0
Nest Displacement	1,149.8	56.0	3.0
TOTAL LOSSES	**1,169.4**	**57.1**	**3.0**
COST/BENEFIT RATIO	**4.2:1.0**	**4.0:1.0**	**3.6:1.0**

[1] Only applies one-half of the estimated benefit.

Monitoring will involve documentation of the numbers of nesting and non-nesting emergences (crawls) by species within each of a series of pre-established survey zones. Additionally, a representative sample of nests will be marked and monitored throughout their incubation periods for the purpose of documenting nest fate. Through this effort the Applicant can determine the numbers of nests washed out, depredated, disoriented by artificial lighting, and/or otherwise impacted by natural and human-related activities on the beach. Data collected from the monitoring program will be entered into a Countywide database managed by the Applicant.

With respect to light management, Indian River County has adopted an ordinance to reduce lighting impacts to nesting and hatchling sea turtles (Section 932.09 of County Codes; Attachment C). The County currently reviews plans for new construction in unincorporated areas of the County for conformance with lighting standards and responds to complaints of lighting problems. Additionally, the County mails preseason notices to coastal property owners in unincorporated areas notifying them of the sea turtle nesting season and applicable lighting regulations.

Limited resources have been available for proactive lighting enforcement and other public awareness programs in Indian River County. As part of the HCP, a proactive light management program will be implemented throughout all unincorporated areas of the County. This program will consist of the following initiatives:

1. The Applicant will conduct annual lighting evaluations of all beachfront properties in unincorporated areas, will develop public awareness and technical assistance programs to help affected property owners bring identified lighting problems into compliance with County code, and will initiate code enforcement against those property owners that fail to resolve identified lighting problems.
2. The Applicant will respond to reports of hatchling disorientations in unincorporated areas of the County, and will initiate code enforcement action, as appropriate.
3. The Applicant will modify its lighting regulations to mimic Florida's Model Lighting Ordinance if proactive light management efforts fail to adequately resolve identified lighting problems.
4. The County will work cooperatively with its municipal partners to identify and resolve lighting problems in incorporated areas.

2.3 Alternative 3: Issuance of the ITP Independent of Other County Measures to Combat Shoreline Erosion

To provide a range of reasonable alternatives for evaluation, the Service considered the consequences of issuing an ITP for emergency shoreline protection under scenarios other than those contained in the preferred alternative proposed by the Applicant. The first of these assesses the consequence of ITP issuance independent of implementation of the County's Beach Preservation Plan.

In estimating take, the Applicant assumes that impacts will occur from the time that an armoring structure is installed until the time that a beach nourishment project occurs at that location. Although many of the assumptions used in the take analysis were conservative (i.e. all permits issued for emergency shoreline protection would lead to permanent armoring structures and all emergency permits would be issued during the first year of the ITP), the analysis assumes that the County's planned beach nourishment projects are permitted as originally designed and constructed on schedule. Due to several environmental issues, particularly nearshore hardbottom impacts, the County's projects face difficult permitting challenges. If the projects are not built on time or if the extent of shoreline protected by the project is reduced, estimates of take will be underestimated.

Accordingly, Alternative 3 involves implementation of the HCP in the absence of any large-scale beach nourishment projects. Using historical erosion rates, the County's shoreline recession model (Appendix C of the HCP) predicts that 64 eligible single and multi-family homes, encompassing 9,099 linear feet (1.72 miles) of shoreline, would be vulnerable to storm damage over the next 30 years in the absence of beach nourishment (Table 8). Of course, these structures would become vulnerable to erosion at various

Table 8
Number and Location of Structure Projected to be Vulnerable to Erosion in the Absence of Beach Nourishment at Various Intervals Over the 30-Year Life of the ITP[1]

Sea Turtle Survey Areas	Interval Since ITP Issuance									
	1-5 years		5-10 Years		10-20 Years		20-30 Years		TOTAL	
	No. of Structures	Length (ft)	No. of Structures	Length (ft)	No. of Structures	Length (ft)	No. of Structures	Length (ft)	No. of Structures	Length (ft)
Sebastian Inlet State Recreation Area	0	0	0	0	0	0	0	0	0	0
Wabasso Beach North	6	438	0	0	2	143	1	110	9	691
Wabasso Beach Middle	9	909	0	0	0	0	0	0	9	909
Wabasso Beach South	6[2]	420	0	0	0	0	0	0	6	420
Baytree, Sea Oaks, and Surrounding Areas	4	1,160	0	0	0	0	1	108	5	1,268
Vero Beach	6	1,305	1	144	1	304	2	562	10	2,315
Unsurveyed	0	0	0	0	0	0	0	0	0	0
South County Beaches	8[3]	1,044	5	654	6	973	6	824	25	3,495
TOTAL	**39**	**5,276**	**6**	**798**	**9**	**1,420**	**10**	**1,604**	**64**	**9,098**

[1] Data provided by Indian River County, as summarized in Appendix C of Applicant's HCP. (Note: Numbers presented in Table 8 differ slightly from those presented in the HCP due to rounding errors.)
[2] Includes Summerplace Petitioners (420 feet of existing structures installed under previous emergency authorization).
[3] Includes Gerstner Petitioners (97 feet of existing structure installed under previous emergency authorization).

intervals over the 30-year life of the ITP. In estimating take under Alternative 3, the Service assigned vulnerability to one of four intervals, 0-5 years, 5-10 years, 10-20 years, and 20-30 years, the same categories used by the Applicant in estimating when beachfront structures would likely become vulnerable to erosion. As in the previous take analysis, it was assumed that all emergency permits for shoreline protection would ultimately result in the construction of permanent armoring structures. Additionally, it was assumed that the structure would be constructed during the first year of the interval in which it became vulnerable. Using this conservative approach and applying Mosier's (1998) data to nesting densities in Indian River County, it is estimated that these structures would result in the displacement of approximately 5,905 loggerhead, 287 green, and 23 leatherback nests over the next 30 years (Table 9). At current nest densities, this represents 3.5 percent of all loggerhead, 2.9 percent of all green turtles, and 4.3 percent of all leatherback nests deposited on County Beaches over the same period.

The minimization and mitigation measures described under the Preferred Alternative would also apply to Alternative 3. The mitigation proposed by the Applicant would mitigate the displacement of turtle nests caused by emergency shoreline protection activities at the ratio of 0.8:1 for loggerheads, 0.8:1 for green turtles and 0.5:1 for leatherback turtles. Thus, additional mitigation would be required or the amount of take authorized by the Service would have to be reduced.

2.4 Alternative 4: Issuance of the ITP Under Conditions Less Favorable to Permanent Beach Armoring

The previous alternative assessed ITP issuance under conditions that would likely result in more take than anticipated under the Applicant's proposed action. Alternative 4 assesses issuance of the ITP under conditions likely to result in less take.

Many of the assumptions used in previous analyses of take were very conservative. Primary among them were the assumptions that all emergency permits would be issued during the first year following ITP issuance and that each permit would result in the construction of a permanent armoring structure. If the Indian River County's BPP is implemented on schedule and if erosion and/or storm events are below historical averages, many of the structures predicted to be vulnerable may not require emergency shoreline protection measures. Additionally, owners of structures determined to be eligible and vulnerable may wish to forestall permanent armoring if it appears that a planned nourishment project is to be constructed in the near future.

Under the Preferred Alternative, take was estimated as the number of nests destroyed or displaced by emergency shoreline protection activities at coastal properties vulnerable to erosion based on an "average" rate of shoreline recession. If erosion rates were below average, fewer eligible structures would be vulnerable, fewer armoring structures would be constructed, and fewer nests would be destroyed or displaced. Thus, for the purpose of estimating take under these conditions, the Service adjusted the number of nests displaced under average erosion rates by applying a conversion factor (provided by the Applicant) derived from the ratio of minimum/average erosion rates.

Table 9
Summary of Sea Turtle Nest Displacement/Destruction Potentially Resulting From Shoreline Protection Measures Authorized by Indian River County Over the 30-Year Life of the ITP in the Absence of Beach Nourishment.

SPECIES	INTERVAL SINCE ITP ISSUANCE (YEARS)	MILES OF ARMORING[1]	NUMBER OF NESTS DISPLACED/ DESTROYED PER YEAR[2]	YEARS UNTIL PERMIT EXPERATION[3]	CUMULATIVE NEST DISPLACEMENT/ DESTRUCTION
Loggerhead	0 to 5	0.999	160.8	30	4,824.0
	5 to 10	0.151	9.9	25	247.5
	10 to 20	0.269	26.6	20	532.0
	20 to 30	0.304	30.1	10	301.0
	TOTAL				**5,904.5**
Green	0 to 5	0.999	8.6	30	258.0
	5 to 10	0.151	0.2	25	5.0
	10 to 20	0.269	0.7	20	14.0
	20 to 30	0.304	1.0	10	10.0
	TOTAL				**287.0**
Leatherback	0 to 5	0.999	.6	30	18.0
	5 to 10	0.151	.1	25	2.5
	10 to 20	0.269	.1	20	2.0
	20 to 30	0.304	.1	10	1.0
	TOTAL				**23.5**

[1] Converted from Totals presented at the bottom of Table 8.
[2] Calculated using Tables 10, 12, and 14 of the Applicant's HCP after substituting shoreline armoring values presented in Table 8 of this EA.
[3] Assumes that permanent structures are constructed during the first year of each period.

For the Wabasso Beach area (North, Middle and South), average erosion rates are – 0.3 ft/yr, while the minimum erosion rate for any of the specific sections analyzed is –0.1 ft/yr. Thus, only 1/3 of the nests estimated to be displaced in Wabasso Beach under average conditions would be affected if minimum rates prevailed. Similarly, in the Vero Beach area, minimum erosion rates (-0.2 ft/yr) are only 40 percent of average rates (-0.5 ft/yr). On South County Beaches minimum rates (-1.8 ft/yr) are 75 percent of average rates (-2.4 ft/yr). By applying these conversion factors to corresponding data presented in Tables 4-6, total nest displacement over the 30-year life of the ITP would be reduced to 395 loggerhead, 19 green, and 1 leatherback nests. At current nest densities, this represents 0.23 percent of all loggerhead, 0.19 percent of all green and leatherback nests deposited on County Beaches over the 30-year life of the ITP.

The minimization and mitigation measures described under the Preferred Alternative would also apply to Alternative 4. The mitigation proposed by the Applicant would mitigate the displacement of turtle nests caused by emergency shoreline protection activities at the ratio of 12.4:1 for loggerheads, 12.2:1 for green turtles and 9.9:1 for leatherback turtles. Thus, the benefits of mitigation proposed by the Applicant would greatly exceed the amount of take authorized by the Service under the ITP.

2.5 Alternatives Considered but Not Analyzed Further

In the HCP, the Applicant presented two additional Action Alternatives to the proposed action, the Retreat and the Acquisition Alternatives (see below). These were considered by the Service but not analyzed in detail. While the Service acknowledges that these alternatives offer benefits to the long-term preservation of the coastline and the conservation of sea turtle nesting habitat, they do not meet the social and economic balancing criteria envisioned under NEPA.

2.5.1 Relocation of Structures farther Landward (The Retreat Alternative)

This alternative would require the landward relocation of all eligible structures potentially vulnerable to erosion thereby moving the structures out of harm's way and allowing the beach to follow it's natural course of change and migration. A retreat from the shore would alleviate the need for armoring and other emergency shoreline protection activities. This alternative is not feasible in many cases, because there is inadequate space on the property to accommodate a meaningful landward relocation. Elsewhere, relocation is constrained by set back requirements, rights of ways, and regulations governing the proximity of structures to wells and septic fields. For many property owners, the cost of structural relocation would be high. Furthermore, unless and until, all eligible and vulnerable structures could be relocated landward, the County would need to maintain some mechanism for permitting emergency shoreline protection. While the Service encourages IRC to incorporate this option into its long-range BPP, it does not appear that the Retreat Alternative constitutes a viable means for addressing the County's short-term needs relative to shoreline protection.

2.5.2 Public Acquisition of all Eligible and Vulnerable Structures (The Acquisition Alternative)

This alternative would involve the purchase of all properties built prior to CCCL regulations that are likely to be vulnerable to storm damage. The Applicant estimates that 31 structures, having an approximate assessed value of $11.3 million, fall into this category. In addition to the purchase costs, the County would incur substantial expenses for the relocation or demolition of purchased structures. Furthermore, there are no certainties that the 31 structures purchased would be the only structures vulnerable to erosion over the next 30 years.

Considerable time would be required to affect the purchase of vulnerable properties, particularly if legal challenges were mounted. Condemnation proceedings might be required if property owners are unwilling to sell. In the interim, these structures would remain vulnerable to erosion and property owners would be allowed, under law, to implement appropriate shoreline protection activities. Thus, unless and until, all eligible and vulnerable structures could be purchased, the Applicant would need to maintain some mechanism for permitting emergency shoreline protection. While the Service encourages Indian River Appliacnt to incorporate this option into its long-range BPP, it does not appear that the Acquisition Alternative constitutes a reasonable means for addressing the County's short-term shoreline protection needs.

3.0 THE AFFECTED ENVIRONMENT

This section of the EA describes the portions of the human environment potentially affected by the proposed and alternative actions. In reviewing a proposed activity for NEPA compliance, the Council on Environmental Quality generally considers the following elements of the human environment:

- Physical Environment (topography, wetlands, floodplains, coastal zones, subsurface conditions, hydrology, soils, energy and mineral resources, toxic substances, and air);
- Land Use (zoning, existing land uses, proposed long-range plans, farmland, and timberland);
- Biological Environment (vegetation, fisheries, wildlife, and threatened/endangered species);
- Cultural Resources (historical sites and standing structures, architectural issues, and archaeological sites);
- Social Interests (human population, human health/safety, and public services);
- Economy (employment, income sources, and economic uses of affected environment); and
- Aesthetics (scenic value, noise and odor).

For the purpose of researching and assessing various human resource and land use issues arising from the Applicant's proposed action, the Service consulted the following information sources:

1. Indian River County 2020 Comprehensive Plan (Comp Plan; IRC 1998a). Adopted in 1998, many of the requisite elements of NEPA review are addressed in the Applicant's Comp Plan. The goal of the Plan is to encourage the most appropriate and efficient use of land, water, and natural resources consistent with the public interest and local, State, and Federal laws.

2. Indian River County Beach Preservation Plan and Beach Preservation Plan Update (Cubit Engineering 1988, IRC 1998b). These plans evaluated coastal conditions throughout the county and presented a strategy for preserving the coast and its natural features through beach nourishment and dune maintenance.

3. Florida Department of State, Division of Historic Resources. The State Historic Preservation Officer reviewed the proposed action with respect to its potential for impacting standing historical structures and significant archaeological resources and rendered an opinion (Attachment B).

4. Chapter 161, Florida Statutes, Beach and Shore Preservation and Chapter 62B-33, Florida Administrative Code, and FDEP 1998 Rules and Procedures for Coastal Construction and Excavation. These documents set forth the rules and regulations

governing the issuance of permits for shoreline protection activities along Florida's coastline.

5. Vero Beach Comprehensive Growth Management Plan, 1990. It was the intent of Indian River County's Comp Plan to "encourage the most appropriate and efficient use of land, water, and natural resources consistent with the public interest; to correct present deficiencies; to effectively and efficiently resolve future problems that may result from the use and development of land within the unincorporated areas of Indian River County; to facilitate the adequate and efficient provision of transportation, potable water, sanitary sewer, parks, recreational facilities, solid waste disposal, storm water management, housing, and other services; and to protect, conserve, and utilize natural resources within the unincorporated areas of Indian River County". Many of the protective measures discussed in the Comp Plan step down from local policies and State and Federal laws enacted to protect various segments of the human environment. The Service has reviewed the Comp Plan and believes the goals, objectives and policies adopted by Indian River County sufficiently document the current status of, and potential future impacts to, human and natural resources within the County, and adequately provide due process to avoid or substantially minimize cumulative adverse effects to these resources.

6. IRC Beach Preservation Plan Economic Analysis – Phase II Funding Sources and Financial Plan (ATM 1999).

7. Indian River County Land Development Regulations –Title IX.

3.1 Physical Environment

The IRC coastline is slightly over 22.25 miles in length. In typical cross section, it consists of a non-vegetated beach extending landward from the mean low water line to the dunes, which are higher in elevation and generally support vegetative communities. One of the primary functional values of the beach/dune system is to dissipate the forces of waves, tides, and currents.

Littoral drift of sediment in the nearshore zone combined with offshore/onshore sand transport plays a dominant role in shaping the County's beaches. As in other east coast Florida counties, there is a net southerly migration of sand along the coastline (IRC 1998b). Hard structures such as jetties, groins and seawalls that extend into the water can alter the natural movement of sand within the nearshore system. Sand collects on the updrift side of these structures, while areas directly downdrift are starved of sand (Kraus 1988). That process is especially apparent around inlets with jetties such as Sebastian Inlet.

During flood tides, sand destined for downdrift beaches in Indian River County is transported inside the inlet where it is lost to the coastal system. To offset this sand loss, the Sebastian Inlet Tax District mechanically places on average about 72,400 cy of sand

per year south of the inlet. Although the current sand bypassing plan adequately compensates for current sand loss, it does not reduce the historic deficit. Since 1924, Sebastian Inlet has reportedly been responsible for impounding about 9.86 million cy of sand destined for IRC beaches (Olsen Associates 1998).

Beaches are dynamic systems, with beach width varying in response to local conditions such as tides, currents, wind and waves. In general, Indian River County's beaches tend to accrete sand during the summer when the ocean is relatively calm, and lose sand during the winter or during severe weather events, such as northeasters and tropical storms (IRC 1998b).

Indian River County is located within the Hurricane Vulnerability Zone (HVZ) where a major hurricane could produce a storm surge of up to 17 feet. Tropical storms can cause rapid beach erosion and serious coastal flooding. The potential for coastal flooding can only be expected to worsen over the next 50 years, as global warming is predicted to cause a sea level rise in IRC of up to 0.5 meters (Palmer 1998). In addition to flooding caused by ocean water that breaches the dune during storms, the barrier island is also subject to flooding from the Indian River Lagoon during abnormally high tides. Fortunately, standing water on the island dissipates fairly quickly, as the sandy soils of the beach/dune system allow for rapid percolation of rain and storm water (IRC 1998b).

To protect coastal properties from erosion, property owners frequently petition the State of Florida to erect permanent armoring structures (seawalls, rock revetments, etc.) seaward of their homes and businesses. Seawalls are defined as shore-parallel structures constructed to prevent both landward retreat of the shoreline and inundation or loss of upland property by wave action or flooding (Kraus and McDougal 1996). Although seawalls are effective in protecting upland shore property, they do little to maintain sandy beaches.

The presence of seawalls and other armoring structures may potentially affect natural shoreline processes and the physical beach environment, although current scientific understanding on these effects is incomplete. It is clear that seawalls prevent long-term recovery of the beach/dune system (i.e. building of the back beach) by physically prohibiting dune formation by wave uprush and wind-blown sand. However, reported topographic effects seaward and adjacent to seawalls often vary and conflict between project sites (Kaufman and Pilkey 1979, Pilkey *et al.* 1984, Kraus 1988, Kraus and McDougal 1996). Much of the controversy surrounding these effects can be attributed to the difficulty in distinguishing between what Pilkey and Wright (1988) term "passive" and "active" erosion. Passive erosion relates to the natural tendencies of the shoreline (e.g., erosion or accretion) at a site prior to the presence of a seawall. Active erosion results from the interaction of the wall with local coastal processes.

Erosion of adjacent downdrift beaches can occur if the updrift wall acts as a jetty and impounds sand (Kraus 1988, Tait and Griggs 1990). Additionally, seawalls can cause wave reflection and scour, processes that accelerate erosion seaward of the structure and steepen the offshore profile (Pilkey *et al.* 1984). Sand can move alongshore

past a seawall, but it is not clear if the longshore sediment transport rate changes (Kraus and McDougal 1996). Pilkey *et al.* (1984) contend that the intensity of longshore currents does increase in front of seawalls and this hastens removal of beach sand. Most likely, the extent to which any of these potentially harmful effects may be realized is largely dependent upon a structure's physical position on the beach relative to the surf zone (Kraus 1988, Tait and Griggs 1990). The closer a seawall is to the surf zone, the greater its potential for altering shoreline processes.

Due to the uncertainty as to the effects of permanent armoring structures, beach nourishment has received preferential treatment as a means for combating erosion and providing shoreline protection. Beach nourishment typically involves the dredging of sand from inlets or offshore "borrow" areas and placing it on an eroded section of coastline. Inland sand sources may also be used. State and County rules require that the introduced material be of compatible and comparable physical nature to the native sands it replaces. Dredging and fill material are discussed in Chapter 934 Title IX of Indian River County's Land Development Regulations and in IRC's BPP (Cubit Engineering 1988, IRC 1998b).

3.2 Land Use

There were 102,211 people living in Indian River County in 1996 and the numbers were growing at about 2.1percent each year (IRC 1998a). Ninety per cent of County residents live within 10 miles of the beach. Additionally, the primary industry in the County is tourism, and the beaches are the most popular tourist destination (ATM 1999). Single and multi-family residential, time-share, and commercial properties make up the bulk of the oceanfront development in IRC. About 4.99 miles or 22.4 percent of all beachfront property is publicly owned. In the City of Vero Beach, the coastline is largely built out and consists of hotels, condominiums, commercial tourist establishments, and single and multi-family residential units.

The Atlantic seaboard and Indian River Lagoon are Indian River County's largest natural resources and the main tourist attractions. Population growth has the potential for causing substantial impacts to native wildlife and vegetative communities within the County. Loss of habitat caused by encroaching development is the most significant impact that threatens the survival of coastal flora and fauna. Conservation easements, fee simple land acquisitions, and financial incentives have all been utilized in IRC to protect the County's sensitive natural resources (IRC 1998a).

There are 12 oceanfront parks in the County, as well as numerous public access points, and several conservation areas. Collectively, five miles of beach, or 22.4 percent of the County's coastline is in public ownership. The park that is most heavily utilized is Sebastian Inlet State Recreation Area (SISRA), which is a State-managed parcel located just south of Sebastian Inlet within the north-south boundaries of the ACNWR. The ACNWR is dedicated to the conservation of critical nesting habitat for sea turtles through acquisition and management of coastal properties.

3.3 Biological Environment

The 22.25-mile oceanfront of Indian River County supports a variety of ecological zones. Some areas have wide, gently sloping beaches with densely vegetated dunes. Areas experiencing severe erosion have steeply sloped beaches with diminished natural dune features. In addition to sea turtles, which are the primary focus of this assessment, the Plan Area provides habitat for a variety of other flora and fauna. This portion of the report provides information on the ecological communities that exist landward of the mean high water line, and gives special consideration to the presence of animals and plants that have been designated by the Federal government and/or the State of Florida as "Endangered" or Threatened" or "Species of Special Concern".

3.3.1 General Description of Plant and Animal Communities

The Florida Natural Areas Inventory (FNAI) defines 82 natural community types throughout Florida. Four of these, beach dune, coastal strand, maritime hammock and tidal swamp are present within the Plan Area. General descriptions of these communities and dominant vegetation found in each are provided below.

3.3.1.1 Beach Dune

The Florida Natural Areas Inventory (FNAI) defines the "beach/dune" system in Indian River County as an active coastal dune with sand substrate, xeric conditions, temperate or subtropical climate, occasional or rare fire events, and a vegetative community consisting of salt-spray tolerant grasses and herbs. Dominant vegetation within this zone consists of sea oats (*Uniola paniculata*) and a variety of "pioneer plants" that exist above the seasonal high water line. These include railroad vine (*Ipomoea pes-caprae*), dune sunflower (*Helianthus debilis*) and sea rocket (*Cakile lanceolata*).

It is estimated that only about 30 percent of the vegetative community within the beach/dune system of the Plan Area is in a relatively natural state (Myers and Ewel 1990). About 15 percent of this zone is in a semi-natural state, and the majority (55 percent) is in a non-natural condition.

Due to harsh environmental conditions, few animals permanently inhabit the beach/dune system, although various shorebirds, such as black-bellied plovers (*Pluvialis squatarola*), ruddy turnstones (*Arenarea interpres*), willets (*Catoptrophorus semipalmatus*) and sanderlings (*Calidris alba*) often forage at the beach/ocean interface. The most conspicuous and characteristic resident animal species on the beach is the ghost crab (*Ocypode quadrata*). A variety of infaunal macroinvertebrates, including the coquina (*Donax* spp.) and sand flea/mole crab (*Emerita talpoida*) inhabit intertidal sands.

3.3.1.2 Coastal Strand

The FNAI defines the coastal strand in Indian River County as a stabilized coastal dune with sand substrate, xeric conditions, subtropical or temperate climate, occasional or

rare fire events, with vegetation consisting of dense stands of salt-spray tolerant and xeric plant species. This back dune community varies in coverage throughout the Plan Area. It is largely absent from areas of residential development and largely intact in publicly-owned and undeveloped tracts.

The dominant vegetation is in the coastal strand is saw palmetto (*Serenoa repens*) and sea grape (*Coccoloba uvifera*). Other vegetation present includes beach bean (*Canavalia maritima*), seaside elder (*Iva imbricata*), creeping oxeye (*Wedelia trilobata*), yucca (*Yucca aloifolia*), prickly pear cactus (*Opuntia stricta*) and various mixed stunted shrubs. Animal life in this zone includes various small mammals such as the cotton rat (*Sigmodon hispidus*), eastern mole (*Scalopus aquaticus*) marsh and eastern cottontail rabbits (*Sylvilagus palustris paludicola and S. floridanus floridanus*, respectively) and spotted skunk (*Spilogale putorius ambarvalis*).

3.3.1.3 Maritime Hammock

The FNAI defines the maritime hammock in Indian River County as a stabilized coastal dune with sand substrate, xeric-mesic conditions, subtropical or temperate climate, rare or no fire events, with vegetation consisting of mixed hardwoods and/or live oak. With the exception of large publicly-owned tracts, only small remnants of this natural community are present within the Plan Area.

The dominant vegetation within the maritime hammock consists primarily of tree and shrub species, such as the cabbage palm (*Sabal palmetto*), red bay (*Persea borbonia*), coral bean (*Erythrina herbacea*) and wild lime (*Zanthoxylum fagara*). Ground cover species are comparatively few.

Animals present within this community include the mammals that also frequent the coastal strand described above, plus raccoons (*Procyon lotor*), gray squirrel (*Sciurus caolinensis*), bobcat (*Felis rufus*), opossum (*Didelphis virginiana*), and a variety of resident and migratory birds, such as the northern cardinal (*Cardinalis cardinalis*) and warbler (*Dendroica* spp).

3.3.1.4 Tidal Swamp

The FNAI defines the tidal swamp in Indian River County as an expansive intertidal and supratidal area occupied primarily by woody vascular macrophytes (e.g., black mangrove, buttonwood, red mangrove, and white mangrove) and various epiphytes and epifauna. Only very small areas of this habitat are present within the Plan Area. They are located almost exclusively in the northern portion of the County in narrow corridors on the east side of State Road A-1-A. Some are tidally connected to the Indian River Lagoon through culverts that extend westward under A-1-A. The dominant plant within these areas is the black mangrove (*Avicennia germinans*). Wildlife species include raccoons, fiddler crabs (*Uca minax*) and various small fish.

3.3.2 Protected Species

Existing data are available from a variety of sources about protected flora and fauna that have been observed within the Plan Area. At some locations where large tracts are in public ownership (e.g., SISRA), intensive surveys have been done for protected plant and animal species. In other portions of the Plan Area, little or no information about the presence/absence of protected species is available.

In an attempt to create a comprehensive list of protected species, information was obtained from all likely sources. Information sources documenting the presence of flora and fauna within the Plan Area include:

- South Florida Multi-Species Recovery Plan (MSRP; USFWS, 1999);
- Sebastian Inlet State Recreation Area Unit Management Plan, November 1988;
- Final Environmental Assessment and Land Protection Plan for the Proposed Expansion of Pelican Island National Wildlife Refuge, March 1991;
- Avalon State Recreation Area Unit Management Plan, April 1997; and
- Florida Natural Areas Inventory, January 2000.

Review of these data sources combined with limited field surveys conducted by the Applicant have indicated the presence or likely occurrence of several species of protected plants and animals within, or in close proximity to, the Plan Area (Table 10). The presence and distribution of these species within the Plan Area is affected primarily by the extent and quality of requisite habitat.

3.3.2.1 Southeastern Beach Mouse (*Peromyscus polionotus niveiventris*)

3.3.2.1.1 Biological Information

Southeastern beach mice are small, buff-colored rodents that once inhabited the beach/dune zone within the Plan Area. They are designated as "threatened" at both the State and Federal levels. Adult beach mice average approximately 136 mm (5.4 inches) in body length and have tails approximately 53 mm (2.1 inches) long. Average weights are approximately 14.5 g (0.5 oz).

Southeastern beach mice typically reside and forage in the sea oats (*Uniola paniculata*) zone of the primary coastal dune (Ehrhart 1978). Other vegetation often found in beach mouse habitat includes dune panic grass (*Panicum amarum*), railroad vine (*Ipomaea pes-caprae*), beach morning glory (*Ipomaea stolonifera*), salt-meadow cordgrass (*Spartina patens*), lambs' quarters (*Chenopdium album*), saltgrass (*Distichlis spicata*) and camphor weed (*Heterotheca subaxillaris*).

Beach mice are generally nocturnal and live in burrows consisting of an entrance tunnel, escape tunnel, and a nest chamber. Usually the nest chamber is about 0.6 to 0.9 m (24 to 35 inches) deep.

Beach mice can reach sexual maturity at about 6 weeks of age and produce litters throughout the year. Their peak in reproductive activity is late summer through early winter when their food source is the greatest. The seeds of sea oats and dune panic grass are the primary forage of beach mice; however small invertebrates will also be eaten in the late spring to early summer when seeds are scarce (Ehrhart 1978). Predators of beach mice include snakes, bobcats, gray foxes, raccoons, skunks, armadillos, raptors and shorebirds, red-imported fire ants, and domestic cats and dogs (USFWS 1999).

Although once numerous along Florida's east coast from Palm Beach County to Volusia County, recent surveys for this species have shown it to be largely absent in the southern portion of its range (USFWS 1999). The general loss of the sea oat community and predation by house cats associated with urbanization of coastal areas are thought to be largely responsible for the decline.

3.3.2.1.2 Site-specific Information for Indian River County

Southeastern beach mice have historically been documented living on the primary dunes in several locations of Indian River County (SISRA, Treasure Shores Park, and several private properties). However, the South Florida MSRP (USFWS 1999) suggests that this species is now most likely extirpated from the County's coastal dune habitat (Bard 1997, Tritaik 1997). One of the last remaining beach populations was located in Treasure Shores Park in Wabasso Beach. The population there declined steadily during the 1990's, and no mice have been documented during the past few years (P. Tritaik, Manager, Pelican Island and ACNWR, personal communication, 2000). This decline has been attributed to loss of habitat caused by beach/dune erosion.

3.3.2.2 West Indian Manatee (*Trichechus manatus latirostris*)

3.3.2.2.1 Biological Information

West Indian manatees are large, air-breathing aquatic mammals that are found in both fresh and salt waters. They are designated as "endangered" at both the State and Federal levels. Adult manatees range from 2.8 to 3.5 m (9.2 to 11.5 ft) in length and weigh 400 to 900 kg (882 to 1,984 lb). Newborn calves weigh approximately 20 to 30 kg (44 to 66 lb) and are 1 to 1.5 m (3.3 to 4.9 ft) in length. Manatees consume large amounts of aquatic vegetation, including seagrasses, bank vegetation, overhanging plants and submerged, rooted or floating vegetation. They are warm-blooded and migrate seasonally. During the winter many congregate at sites in south Florida or seek thermal refugia (e.g., springs and power plant discharges) in north Florida.

Aerial surveys conducted during the winter by FWC (formerly FDEP) indicate that the population of manatees in Florida is between 2,200 and 2,700 individuals (USFWS 1999). Although the number of animals observed during annual counts has increased in recent years, it is unknown whether the population is actually increasing or if the techniques and accuracy of the aerial surveys are improving. Manatees have no

natural predators, and a substantial proportion of manatee mortality each year is related to human activities, particularly boat collisions.

Table 10
State and/or Federal Listed Species Potentially Occurring Within or Adjacent to the Plan Area

Species		Federal Status[1]	State Status[1]
Scientific Name	**Common Name**		
Fauna			
Mammals			
Peromyscus polionotus niveiventris	Southeastern Beach Mouse	T	T
Trichechus manatus latirostris	West Indian Manatee	E	E
Reptiles			
Caretta caretta	Loggerhead Turtle	T	T
Chelonia mydas	Green Turtle	E	E
Dermochelys coriacea	Leatherback Turtle	E	E
Drymarchon corais couperi	Eastern Indigo Snake	T	T
Eretmochelys imbricata	Hawksbill Turtle	E	E
Gopherus polyphemus	Gopher Tortoise		SSC
Lepidochelys kempii	Kemp's Ridley Turtle	E	E
Nerodia fasciata taeniata	Atlantic Salt Marsh Snake	T	T
Birds			
Ajaia ajaja	Roseate Spoonbill		SSC
Egretta caerulea	Little Blue Heron		SSC
Egretta rufescens	Reddish Egret		SSC
Egretta thula	Snowy Egret		SSC
Egretta tricolor	Tri-colored Heron		SSC
Eudocimus albus	White Ibis		SSC
Falco peregrinus tundris	Peregrine Falcon		E
Haematopus palliatus	American Oystercatcher		SSC
Mycteria americana	Wood Stork	E	E
Pelecanus occidentalis	Brown Pelican		SSC
Rhynchops niger	Black Skimmer		SSC
Sterna antillarum	Least Tern		T
Fish			
Centropomus undecimalis	Common Snook		SSC
Rivulus marmoratus	Mangrove Rivulus		SSC

Table 10
(Continued)

Species		Federal Status	State Status
Scientific Name	**Common Name**		
Flora			
Achrostichum danaeifolium	Giant Leather Fern		E
Encyclia tampensis	Butterfly Orchid		T
Glandularia maritima	Coastal Vervain		E
Halophila johnsonii	Johnson's Seagrass	T	
Opuntia stricta	Prickly Pear Cactus		T
Remirea maritima	Beach Star		E
Scaevola plumieri	Inkberry		T
Myrcianthes fragrans	Simpson's Ironwood		T
Tephrosia angustissima var. curtissii	Coastal Hoary-Pea		E
Tilandsia fasciculata	Common Wild Pine Airplant		T

[1] E = Endangered; T= Threatened; and SSC = Species of Special Concern.

3.3.2.2.2 Site-specific Information for Indian River County

West Indian manatees have been documented within both inshore (Indian River Lagoon) and nearshore (Atlantic Ocean) waters of Indian River County. They occasionally use the Sebastian Inlet as a passageway between the two water bodies. Although manatees prefer the calmer waters of the lagoon, they may venture into the ocean to migrate to other areas, feed around the inlet jetties, escape mating aggregations, or if they are sick or disoriented (A. Spellman, Biologist, FWC, personal communication, 2000).

3.3.2.3 Atlantic Salt Marsh Snake (*Nerodia clarkii taeniata*)

3.3.2.3.1 Biological Information

Salt marsh snakes are small, slender aquatic reptiles that inhabit estuarine wetlands. They are designated as "threatened" at both the State and Federal levels. This rough-scaled snake is identified by a pattern of dorsal longitudinal stripes and blotches on a mainly pale olive-colored background. Although they appear to prefer salt marsh habitat dominated by *Spartina* and/or *Salicornia*, they have also been observed along tidal creeks, ditches and pools and in black mangroves. Although adults may reach 61 cm (2 ft) in length, they are infrequently observed due to their nocturnal behavior.

There are no estimates concerning the population size of salt marsh snakes, but it is assumed that their numbers are in decline. The species' geographic distribution at the time of Federal listing was restricted to the estuarine marshes on Florida's east coast from Volusia County south through Indian River County (McDiarmid 1978, USFWS 1999). However, the South Florida MSRP (USFWS 1999) indicates that the current distribution of the Atlantic salt marsh snake is largely confined to the brackish and coastal marshes of Volusia County. The biggest threat to the continued existence of the species is loss of habitat.

3.3.2.3.2 Site-specific Information for Indian River County

The South Florida MSRP (USFWS 1999) indicates that the distribution of the Atlantic salt marsh snake in Indian River County is uncertain. Even if some individuals were still present, they would likely be limited to the estuarine wetlands near the north end of the County.

3.3.2.4 Eastern Indigo Snake (*Drymarchon corais couperi*)

3.3.2.4.1 Biological Information

Eastern indigo snakes are large dark-colored reptiles that are known to inhabit coastal strand communities within the Plan Area. They are designated as a "threatened"

species at both the State and Federal levels. They are mild tempered, smooth-scaled snakes that often reach lengths of 1.8 to 2.4 m (6 to 8 ft), making them one of the largest snakes in North America. Their diet includes small mammals, birds, frogs, lizards and other snakes.

Indigo snakes are present in a variety of habitats throughout Florida, and will often use the burrows of gopher tortoises, especially during colder winter months. Due to their comparatively large size, indigo snakes have few natural enemies. Although their passive demeanor previously caused them to be heavily collected for the pet trade, their listing as a threatened species has diminished this threat. The single leading threat to the continued existence of the species is the loss and fragmentation of habitat, as indigo snakes require fairly large tracts for survival.

3.3.2.4.2 Site-specific Information for Indian River County

Eastern indigo snakes are found throughout Florida, including Indian River County (McDiarmid 1978, USFWS 1999). However, because of their habitat requirements, it is likely that they would be infrequent residents of the largely developed, fragmented habitats along the Atlantic shoreline.

3.3.2.5 Wood Stork (*Mycteria americana*)

3.3.2.5.1 Biological Information

Wood storks are large, white birds with black wing and tail feathers that are known to inhabit the mangrove islands in the Indian River Lagoon immediately west of the Plan Area. They are designated as "endangered" at both the State and Federal levels. The only species of stork that is native to North America, wood storks are present in relatively sparse numbers in Florida and southeastern Georgia. They are long-legged wading birds that average approximately 85 to 115 cm (35 to 45 in) in head-to-tail length and have a wingspread of approximately 150 to 165 cm (60 to 65 in). They typically nest in cypress swamps and mangrove forests and forage for small fish and aquatic organisms in shallow ponds, flooded pastures and ditches. Their annual nesting success is highly dependent on hydrologic regimes, and nesting failures are typically associated with water levels being either unusually low or high. Field surveys indicate that there are between 2,300 and 5,600 mating pairs of wood storks in Florida (USFWS 1999). Because wood storks have no major natural threats, loss of wetlands and modifications to natural hydrological cycles are the primary threats to the continued existence of the species.

3.3.2.5.2 Site-specific Information for Indian River County

Wood storks are found throughout Florida, including Indian River County. Breeding colonies have been located on islands in the Indian River Lagoon adjacent to the Plan Area (Kale 1978, USFWS 1999). However, because of their prevalent use of

freshwater and estuarine habitats for nesting, roosting, and foraging, they would not likely be found along the Atlantic shoreline in the Plan Area.

3.3.2.6 Johnson's Seagrass (*Halophila johnsonii*)

3.3.2.6.1 Biological Information

Johnson's seagrass is a short-bladed aquatic plant inhabiting shallow estuarine waters along the east coast of peninsular Florida. It has recently been designated as a "threatened" species by the Federal government, but is not listed by the State of Florida. Johnson's seagrass often inhabits tidal shoals near open-water inlets, where it appears to aid in stabilizing shifting sediments. The major threats to this species are loss of habitat through dredge/fill activities and degradation of water clarity.

3.3.2.6.2 Site-specific Information for Indian River County

Johnson's seagrass has been documented in the Indian River Lagoon adjacent to the Plan Area. However, this portion of the lagoon is not designated as critical habitat (NOAA 50 CFR Part 226). Due to the turbulence present in the surf zone, this species would not likely occur on the Atlantic side of the barrier island.

3.3.2.7 Sea Turtles

Of the seven species of sea turtles found in the world, five are known to inhabit eastern Florida waters: hawksbill (*Eretmochelys imbricata*), Kemp's ridley (*Lepidochelys kempi*), leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) turtles. The loggerhead, green, and leatherback nest regularly on County Beaches. The Kemp's ridley and hawksbill are infrequent nesters on Florida's east coast, and have never been recorded nesting on County Beaches (Meylan et. al. 1995). Current understanding of the biology and ecology of sea turtles is summarized in a recent publication, *The Biology of Sea Turtles*, edited by Lutz and Musick (1997).

3.3.2.7.1 Loggerhead Turtle (*Caretta caretta*)

3.3.2.7.1.1 Biological Information

The loggerhead turtle (*Caretta caretta*) was federally listed on July 28, 1978 as a threatened species under the ESA (43 FR 32800). Internationally, it is considered "endangered" by the World Conservation Union (Hilton-Taylor 2000) and is listed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Circumglobal in range, this species can be found in temperate, subtropical, and tropical waters of the Atlantic, Pacific, and Indian Oceans (Dodd 1988). With the exception of brief periods when adult females emerge on sandy beaches to nest, loggerheads, as do other sea turtles, spend their entire lives in marine and estuarine waters.

The National Marine Fisheries Service (NMFS) and the USFWS (NMFS and USFWS 1991a) summarized the geographic distribution of loggerhead turtle nesting. Approximately 88 percent of nesting by this species occurs in the southeastern United States, Oman, and Australia. Approximately 50,000 to 70,000 loggerhead turtle nests are deposited on southeastern U.S. beaches annually, ranking this rookery as the second largest in the world (NMFS and USFWS 1991a, FWC unpublished data, Georgia Department of Natural Resources unpublished data, South Carolina Department of Natural Resources unpublished data, North Carolina Wildlife Resources Commission unpublished data). The vast majority of nesting in the U.S. occurs in Florida. The beaches of east central and southeast Florida from Brevard to Broward Counties are especially prolific nesting areas, accounting for about 90 percent of the total nests deposited each year in Florida (Meylan *et al.* 1995).

The adult loggerhead foraging grounds for the south Florida nesting population are thought to be around the Caribbean Islands, such as Cuba and the Dominican Republic, as well as around the eastern seaboard of the United States, the Bahamas, Florida Keys, and Gulf of Mexico (Meylan *et al.* 1983, Henwood 1987, Rankin-Baransky 1997). The average female makes reproductive migrations between her foraging grounds and nesting beach every two or three years (Richardson and Richardson 1982, Murphy and Hopkins 1984).

Mating season in southeastern Florida begins in early March, prior to commencement of nesting. The first loggerhead nests begin to appear in late April, and the last nests are deposited in early to mid September (NMFS and USFWS 1991a; Meylan *et al.*, 1995). Nesting peaks during the months of June and July. Aerial surveys have shown the numbers of adult turtles off the east coast of Florida to be about 15 times higher in the spring and summer than in the fall and winter, indicating that adults migrate from elsewhere to mate and nest (Thompson 1984, National Research Council 1990).

The general nesting process for all species of sea turtles is stereotypical, with subtle variations (Miller 1997). Hailman and Elowson (1992) documented the sequential behaviors associated with loggerhead turtle nesting (ascending the beach, making the body pit, digging the egg chamber, laying eggs, filling the egg chamber, covering the body pit, and returning to the surf). Unless otherwise noted, the phases described below for loggerheads apply to the other sea turtle species as well.

Nesting occurs almost exclusively at night. Female sea turtles emerge from the surf zone and ascend the beach in search of an appropriate place to construct their nests. If a suitable nesting site cannot be found, the turtle will return to the ocean and will typically select another site either later that night or the next night (Miller *et al.* In Press).

Sea turtle eggs require a low-salinity, high-humidity, well-ventilated substrate that is not inundated by tidal overwash for development (Miller 1997). Various authors have suggested that abrupt changes in temperature, moisture, salinity and/or beach slope along the beach profile may aid in nest site selection (Stoneburner and Richardson 1981, Wood and Bjorndal 2000). Nest placement may also be influenced by local lighting conditions

and/or the presence of structures on the beach. On urban beaches, where a bright sky glow is often present landward of the beach, Salmon *et al.* (1995) found that females tended to concentrate their nests on the beach within the darker silhouettes of large condominiums, and nested with lower frequency in the more illuminated areas between the structures. Mosier (1998) and Bouchard *et al.* (1998) observed that nest densities in front of armoring structures were reduced relative to areas of natural dune vegetation.

Once a suitable site is found, the turtle will begin excavating a shallow body pit. At the rear of this depression she will then excavate an egg chamber, which is about 60 cm (24 inches) deep (Ernest and Martin 1999). Into the egg chamber, the loggerhead female will usually deposit between 100 and 120 eggs, (Ehrhart 1979, Raymond 1984, Ehrhart and Witherington 1987, Ehrhart and Witherington 1987, Steinitz 1990, Broadwell 1991, Ernest and Martin 1993, Ehrhart 1995). Once egg-laying is complete, the female packs the top of the nest chamber with moist sand with her rear flippers then covers the entire body pit by throwing sand backwards with her front flippers. The turtle then crawls back to ocean. The average time that a loggerhead turtle spends on dry land during the entire nesting process is 63.0 minutes (Hailman and Elowson 1992). The young receive no subsequent parental care.

Female sea turtles typically lay several clutches of eggs during each season that they nest (Ehrhart 1982). In a review of literature on loggerhead turtles, Ehrhart (1989) concluded that the estimate of 4.1 nests per female made by Murphy and Hopkins (1984) was the current best estimate of mean intraseasonal clutch frequency in this species. Renesting intervals are approximately two weeks (Hirth 1980, Ehrhart 1982). Individuals usually return to the same general area to lay successive clutches (Carr 1967, Dodd 1988). Recent genetic evidence supports long-held beliefs that sea turtles exhibit a natal homing instinct; upon reaching reproductive age, they return to their natal beaches to nest (Meylan *et al*. 1990, Bowen *et al*. 1993, Allard *et al*. 1994).

Sea turtle nests incubate for variable periods of time. The loggerhead turtle incubation period ranges from approximately 49 to 80 days for nests left *in situ* (in place; Dodd 1988). The warmer the temperature of the sand surrounding the egg chamber, the faster the embryos develop (Mrosovsky and Yntema 1980). Sediment temperatures prevailing during the middle-third of the incubation period also determine the sex of hatchling sea turtles (Mrosovsky and Yntema 1980). Moisture conditions in the nest similarly influence incubation period, hatching success, and hatchling size (McGehee 1990).

Sea turtle hatchlings do not typically emerge from the nest immediately after hatching from their eggs. Instead, they remain in the egg chamber for several days before ascending to the beach surface (Christens 1990). The inclusive time between the date a clutch of eggs is laid and the date the first hatchling emerges from the nest is termed the incubation period. The average incubation period for loggerhead nests along the central and south Florida east coast is typically between 49 and 54 days (Ehrhart and Witherington 1987, EAI 2000 and 2001a).

Hatchlings emerge from their nests almost exclusively at night, presumably using decreasing sand temperature as a cue (Hendrickson 1958, Mrosovsky 1968, Witherington *et al.* 1990). Nighttime emergences are beneficial, because the risks of predation and hyperthermia are reduced. An abrupt lowering of sand temperatures after nightfall apparently increases hatchling activity and elicits an emergence response. Even after the initial emergence of hatchlings from the nest, there may be secondary emergences on subsequent nights (Carr and Ogren 1960, Ernest and Martin 1993). The number of hatchlings leaving each nest is extremely variable. Ehrhart and Witherington (1987) reported that average emergence success (percentage of eggs that produce hatchlings which escape from the nest) of 85 nests in southern Brevard County was 63.7 percent. Thus, the average loggerhead nest (116 eggs) would produce about 74 hatchlings.

Emergence marks the beginning of a period of high activity during which hatchlings enter the sea and swim away from land in a "frenzy" (Wyneken and Salmon 1992). Hatchlings may use a variety of cues to guide them from the nest to offshore, pelagic environments where they spend their early years (Carr 1987, Bolten *et al*. 1993, Witherington 1994, Bolten and Balazs 1995). Hatchlings first use light cues to find the ocean. On natural, undeveloped beaches, ambient light reflected off the ocean creates a relatively bright horizon compared to the dark dune and vegetation landward of the nest. This contrast guides the hatchlings to the ocean (Witherington 1992, Salmon *et al*. 1992).

Upon entering the surf, hatchlings swim incessantly in an offshore direction for about 20 hours (Wyneken and Salmon 1992). Wave direction and magnetic fields are thought to be responsible for leading the hatchlings to offshore habitats where they spend the next phase of their life history (Carr 1986 and 1987, Salmon and Lohmann 1989, Lohmann *et al.* 1990, Wyneken *et al.* 1990, Lohman 1991, Wyneken and Salmon 1992, Light *et al.* 1993, Lohmann and Lohmann 1994).

Western Atlantic loggerheads are estimated to spend about ten years in the pelagic environment (Bolton and Balazs 1995). When loggerhead turtles reach the size of 40 to 60 cm (16 to 24 inches) straight carapace length, they move into various inshore estuaries or reef-system habitats in the shallow coastal waters of the western Atlantic (Carr 1986 and 1987). The nearshore regions where juvenile and subadult loggerheads live and forage have been termed developmental habitats. Loggerheads may reside in these developmental habitats either seasonally or year-round until they reach sexual maturity, which is estimated to occur between 20 to 30 years or more of age (Frazer and Ehrhart 1985, Klinger and Musick 1995, Parham and Zug 1997).

Genetic research involving mitochondrial DNA (mtDNA) has identified five distinct loggerhead nesting sub-populations/nesting aggregations in the western North Atlantic (Bowen 1994 and 1995, Bowen et al. 1993, Encalada et al. 1998, Pearce 2001):

- Northern (North Carolina, South Carolina, Georgia, and northeast Florida);
- South Florida (from 29°N latitude on Florida's east coast to Sarasota on Florida's west coast);
- Dry Tortugas, Florida

- Northwest Florida (Eglin Air Force Base and the beaches near Panama City); and
- Yucatan (eastern Yucatan Peninsula).

Data indicate that gene flow between these five regions is very low. If nesting females are extirpated from one region, dispersal from adjacent sub-populations will not be sufficient to replenish the depleted stock. The Northern Sub-population has declined substantially since the early 1970s, but most of that decline occurred prior to 1979. No significant trend has been detected in recent years (TEWG 1998 and 2000). Adult loggerheads of the South Florida Sub-population have shown significant increases over the last 25 years, indicating that the sub-population is recovering, although a trend could not be detected from the State of Florida's Index Nesting Beach Survey program from 1989 to 1998. Nesting surveys in the Northwest Florida and Yucatan Sub-populations have been too irregular to date to allow for a meaningful trend analysis (TEWG 1998 and 2000). The Dry Tortugas Sub-population has only recently been identified as a distinct management unit (Pearce 2001).

3.3.2.7.1.2 Site-Specific Information for Indian River County

Indian River County's 22.25 miles of beach supports about 4.6 percent of the total loggerhead nesting in the State of Florida (Meylan *et al.* 1995). On average, about 5,603 loggerhead nests are deposited in the County each season yielding an overall nest density of 252 nests per mile. The areas of highest nest densities are north of Vero Beach, while lowest densities occur in the urban area of Vero Beach and southern County beaches. SISRA and Wabasso Beach have been deemed critically important nesting areas and hold some of the highest loggerhead turtle nesting densities in the State (Meylan *et al.* 1995).

The earliest recorded nesting by a loggerhead in Indian River County was on April 15. The latest nest was recorded on September 15.

3.3.2.7.2 Green Turtle (*Chelonia mydas*)

3.3.2.7.2.1 Biological Information

In 1978, the breeding populations of the green turtle (*Chelonia mydas*) in Florida and on the Pacific Coast of Mexico were federally listed as endangered; all other populations were listed as threatened (43 FR 32800).

The green turtle is a circumglobal species in tropical and subtropical waters. The major green turtle nesting colonies in the Atlantic Ocean occur on Ascension Island, Aves Island, Costa Rica, and Surinam (NMFS and USFWS 1991b). Nesting in the United States occurs in small numbers in the U.S. Virgin Islands and on Puerto Rico and in larger numbers along the east coast of Florida, particularly in Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties.

Allard *et al*. (1994) concluded that the Florida nesting population of green turtles is genetically distinct, and Meylan *et al*. (1995) stated that the Florida green turtle nesting aggregation deserves recognition as a regionally significant colony. Brevard County accounts for nearly 39.5 percent of nesting green turtles in Florida.

The nesting behavior and life history stages of green turtles are similar to those of loggerheads, although there are slight differences. For example, the eggs of green turtles tend to be larger and deposited deeper on the beach than those of loggerheads. Additionally, green turtles typically do not begin nesting in Florida until late May. Estimates of the number of green turtle nests deposited each year in Florida range from several hundred to over 8,400 (FWC, unpublished data).

Like the loggerhead, green turtles lay multiple clutches of eggs during the nesting season. Based on research conducted in south Brevard County during 1991 and 1992, Johnson (1994) estimated that green turtles deposited one to seven clutches during the nesting season with an average of about three nests per female. However, he cautioned that, because of inherent biasing factors, the true mean probably lies between 3 and 4.

The mean clutch size of green turtle nests is usually 110 to 115 eggs, but this mean varies among populations (NMFS and USFWS 1991b). Witherington and Ehrhart (1989) reported an average clutch size of 136 eggs for 130 clutches on the east coast of Florida. In south Brevard County, Johnson (1994) reported a mean clutch size of 131 eggs. When data from 1985-1990 were combined, Johnson (1994) estimated overall hatchling emergence success to be 56.7 percent. Thus, the average green turtle nest in south Brevard County produces 74.8 hatchlings. Incubation periods for green turtle nests range from approximately 48 to 70 days (Marquez 1990).

In the State of Florida, green turtle nesting appears to be increasing, at least in the last half of the twentieth century (Dodd 1982, Meylan *et al.* 1995). During the period from 1989 to present, green turtle nesting in Florida has shown a clear biannual periodicity, with relatively low nest numbers being recorded in odd-numbered years and high nest numbers being documented in even-numbered years (Witherington and Koeppel 1999, FWC unpublished data).

3.3.2.7.2.2 Site-specific Information for Indian River County

Indian River County Beaches support about 5.4 percent of the State's green turtle nests (Meylan *et al.* 1995). During an average year, about 300 nests are deposited on County Beaches. This equates to about 13.5 nests per mile for the entire Plan Area. As with the loggerhead, green turtle nest densities tend to be higher north of Vero Beach and lower from Vero Beach south. The ACNWR in Brevard and Indian River Counties contains some of the State's highest concentrations of green turtle nests. Additionally, the nearshore reefs that parallel much of the IRC's coastline serve as an important developmental habitat for juvenile green turtles (Ehrhart 1992).

The earliest recorded nesting by a green turtle in Indian River County was on May 9. The latest nest was recorded on September 22.

3.3.2.7.3 Leatherback Turtle (*Dermochelys coriacea*)

3.3.2.7.3.1 Biological Information

The leatherback turtle (*Dermochelys coriacea*), the largest of the extant species of sea turtle, was federally listed as an endangered species in 1970 (35 FR 8491). Unlike other sea turtles, the carapace, or top shell, of the leatherback is not covered with bony plates. Rather, its carapace is composed of a black, oil-saturated, rubber-like tissue that is strengthened by a mosaic of thousands of small bones just below the outer skin of the carapace. The morphology of the leatherback is so distinct that it is placed in a separate family (Dermochelyidae) from other extant species of sea turtles (Cheloniidae; NMFS and USFWS 1992).

Whereas the other species of sea turtles tend to inhabit relatively shallow coastal waters where they feed on bottom dwelling plants and animals, leatherbacks tend to be pelagic (Pritchard and Trebbau 1984). They feed primarily on soft-bodied animals, such as jellyfish, that are abundant in the open ocean (Lazell 1980, Hendrickson 1980, Shoop and Kenney 1992).

Circumglobal in range, leatherback turtles travel great distances between their winter foraging and summer nesting grounds (Goff *et al*. 1994, Girondot and Fretey 1996). The leatherback turtle is found in the Atlantic, Pacific, and Indian Oceans and has been spotted as far north as the Barents Sea, Canadian Maritime Provinces and Alaska, and as far south as Chile, the Cape of Good Hope, and New Zealand (Pritchard and Trebbau 1984). The leatherback can inhabit colder waters than other sea turtles, because it is apparently able to maintain an internal temperature that exceeds ambient water temperature; it may be active at temperatures reportedly as low as 0 degrees Celsius (Frair *et al*. 1972, Goff and Lien 1988).

Nesting grounds are distributed circumglobally (40º North to 35º South Latitude), with the largest known nesting ground occurring on the Pacific Coast of southern Mexico. The total population of mature females worldwide has been estimated to be 34,500 (Spotila *et al*. 1996). At present, two of the largest populations of leatherbacks occur in the Western Atlantic in French Guiana and Suriname (Spotila *et al.* 1996). In French Guiana, over 50,000 nests were recorded in 1988 and 1992 (Girondot and Fretey 1996). Nesting occurs frequently, but in lesser numbers, from Costa Rica to Columbia and in Guyana and Trinidad (National Research Council 1990). Nesting in the United States occurs primarily in Puerto Rico, the U.S. Virgin Islands, and southeastern Florida. Only about 16 to 31 leatherback turtles were thought to nest annually in Florida (Meylan *et al.* 1995, NMFS and USFWS 1992). However, that figure appears to have increased significantly over the last decade (Witherington and Koeppel 1999). The majority (more than 90 percent) of the leatherback turtle nests recorded in Florida between 1988 and 1992 occurred in St. Lucie, Martin, and Palm Beach Counties.

Leatherbacks are thought to migrate to their nesting beach about every two to three years and nest about six times during the nesting season (NMFS and USFWS 1992, Miller 1997). Nesting by this species in Florida typically begins and ends earlier in the season than for the other species, with the first nests being recorded in late February or early March and the last nests in July (Meylan *et al.* 1995). Tucker (1989) and Tucker and Frazer (1991) reported that leatherback turtles nested an average of five to seven times per year, with a mean internesting interval of about nine to ten days.

The mean annual clutch size of leatherback turtles varies from 65 to 80 yolked eggs (Tucker and Frazer 1991, NMFS and USFWS 1992), and incubation periods vary from 55 to 75 days (NMFS and USFWS 1992). On Hutchinson Island, Florida, in Martin and St. Lucie Counties, the average leatherback nest contains 76.8 yolked eggs and the average emergence success is 50.1 percent (Ecological Associates, Inc., unpublished data, 1998-2000). Thus, a typical leatherback nest unaffected by predation or storms produces about 38 hatchlings. Incubation periods for leatherback nests in Florida are generally longer than for loggerhead and green turtle nests mainly because of the leatherback's tendency to deposit nests earlier in the season when cooler temperatures prevail.

3.3.2.7.3.2 Site-specific Information for Indian River County

The bulk of leatherback nesting in Florida occurs just south of IRC in St. Lucie, Martin, and Palm Beach Counties (Meylan *et al.* 1995). Indian River County only receives about 1.7 percent of the State's leatherback nesting each year. On average there are about 0.8 nests per mile in IRC, totaling about 18 nests per year. Leatherback nests have been recorded throughout County Beaches.

The earliest recorded nesting by a leatherback in Indian River County was on March 26. The latest nest was recorded on July 7.

3.3.2.7.4 Hawksbill Turtle (*Eretmochyles imbricata*)

3.3.2.7.4.1 Biological Information

The hawksbill turtle (*Eretmochelys imbricata*) occurs in all of the tropical and subtropical oceans. It was federally listed as endangered in 1970 (35 FR 8491). Throughout their range, hawksbills typically nest at lower densities compared to green and loggerhead turtles (National Research Council 1990). The low numbers may be the direct result of long-term over-fishing. Although they are regularly spotted in coastal waters and reefs off south Florida, few hawksbills nest on Florida beaches (Meylan *et al*. 1995). Most of the Western Atlantic nesting takes place on the Yucatan Peninsula, Belize, Nicaragua, Panama, Venezuela, Antiqua, and other Caribbean islands (NMFS and USFWS 1993). Hawksbills have an apparent preference for remote beaches with dense

shrubbery on the landward side of the intertidal zone where offshore reefs or rock outcrops are in the vicinity (National Research Council 1990).

Hawksbills share many of the same life-history traits as loggerhead and green turtles. They are thought to migrate to their nesting beach about every 3 years, and nest about 2 to 3 times during the nesting season (Miller 1997). The average renesting interval is about 14.5 days. Hawksbills lay an average of 140 eggs per clutch, and the average incubation period is 59.2 days (NMFS and USFWS 1993).

3.3.2.7.4.2 Site-specific Information for Indian River County

Between the years of 1979 and 1992, only 11 hawksbill nests were reported in the State of Florida. These nests were documented in Broward, Dade, Martin, Monroe, Palm Beach, and Volusia Counties (Meylan *et al.* 1995). Nine hawksbill nests were counted in Florida from 1993 to 1999. All were in Broward, Dade, Monroe and Palm Beach Counties and deposited between June and December (FDEP Unpublished Annual Nesting Data, 1999 and 2000). However, hawksbill tracks are difficult to differentiate from those of loggerheads and may not be recognized by monitoring personnel. Therefore, nesting surveys in Florida likely underestimate the actual number of hawksbill nests deposited each year (Meylan *et al*. 1995).

Although no hawksbill nests have been documented in Indian River County, the turtles can probably be found inhabiting some reefs and ledges in nearshore waters of the County.

3.3.2.7.5 Kemp's Ridley Turtle (*Lepidochyles kempii*)

3.3.2.7.5.1 Biological Information

The Kemp's ridley sea turtle (*Lepidochelys kempii*) has received protection in Mexico since the 1960's and was listed as endangered under United States law in 1970 (35 CFR 18320). Together with the olive ridley, they are the smallest of the extant species of sea turtles. Kemp's ridley distribution is mainly limited to the Gulf of Mexico and Western Atlantic with occasional sightings in the Eastern Atlantic. Adult turtles are thought to spend most of their time in the Gulf of Mexico, while juveniles and subadults also regularly occur along the eastern seaboard of the United States (USFWS and NMFS 1992). The Kemp's ridley is carnivorous, feeding on swimming crabs, mollusks, jellyfish, and fish, with blue crabs apparently a preferred food.

Kemp's ridleys nest singly or in large groupings called arribadas. Unlike the loggerhead, Kemp's ridley nesting occurs during the day. The majority of nesting takes place on western Gulf of Mexico beaches primarily in the Mexican states of Tamaulipas and Veracruz (USFWS and NMFS 1992; USFWS 2001). Kemp's ridleys are thought to nest every one or two years, depositing an average of 2.5 clutches per nesting season

(TEWG 2000). The renesting interval is between 20 and 28 days, and the mean clutch size is about 110 eggs (Miller 1997).

3.3.2.7.5.2 Site-specific Information for Indian River County

Only seven Kemp's ridley nests have been documented in the State of Florida from 1979 through 1999 (Johnson *et al.* 1999, FDEP, unpublished nesting data). The nests were found in Volusia, Pinellas, Sarasota, and Lee Counties in the months of May and June. While it is likely that Kemp's ridleys utilize the nearshore Atlantic waters of Indian River County and may occasionally occur in the Indian River Lagoon (Ehrhart *et al.* 1999), there have been no documented nests in Indian River County (Meylan *et al.* 1995, FDEP, unpublished nesting data).

3.3.3 Natural and Human Threats to Sea turtles and Other Protected Species in Indian River County

3.3.3.1 Sea Turtles

Sea turtles nesting on County Beaches, as elsewhere in Florida, face a variety of natural and human-related threats (NMFS and USFWS 1991a and b). Natural threats include nest predation and storms. Various anthropogenic threats facing turtles today include shrimp trawling, long-line and other fisheries, beach development, dredging, entanglement, oil platform removal, collisions with boats, directed take, power plant entrainment, beach vehicles, beach lighting, beach replenishment, toxins, and ingestion of plastics/debris (National Research Council 1990). Most pertinent to this EA are impacts associated with coastal development and beachfront construction activities.

3.3.3.1.1 Predation

Depredation of sea turtle eggs and hatchlings by natural and introduced species occurs on almost all nesting beaches. Most common predators in the State of Florida are ghost crabs (*Ocypode quadrata*), ants, raccoons (*Procyon lotor*), feral hogs (*Sus scrofa*), foxes (e.g., *Urocyon cinereoargenteus*) and armadillos (*Dasypus novemcinctus*). Raccoons, ghost crabs, and red imported fire ants (*Solenopsis invicta*) are the primary predators found on the beaches of IRC. Although not considered a typical form of predation, roots of sea oats (*Uniola paniculata*), railroad vine (*Ipomoea pescapre*), and other dune plants sometimes invade the nest cavity and penetrate incubating eggs. This occurs primarily in nests laid high on the beach at or landward of the toe of the dune.

In the last few nesting seasons, raccoons have been responsible for destroying up to 15 percent of all loggerhead nests deposited on Wabasso Beach (P. Tritaik, Manager, Pelican Island and ACNWR, personal communication, 2000). Other survey areas in Indian River County have reported depredation rates of less than 5 percent (C. Perretta, FWC principal permit holder, private consultant, personal communication, 2000, R.

Johns, Manager, Sebastian Inlet State Recreation Area, personal communication, 2000, W. Stay, FWC principal-permit holder, City of Vero Beach, personal communication, 2000). However, because there is no uniform method of marking and monitoring nests, it is difficult to compare data collected by the four different groups currently monitoring nesting activities on the County's beaches. Furthermore, there is presently no monitoring program at all in place for the south end of the County. Consequently, an accurate assessment of Countywide predation rates cannot be determined.

3.3.3.1.2 Beach Erosion and Storms

Erosion, inundation, and accretion appear to be the major abiotic factors that negatively affect incubating egg clutches (NMFS and USFWS 1991a). Short-term erosion events (e.g., storms) are a natural phenomenon throughout the tropics and sub-tropics where both the number of turtle nests, and the amount of storm activity vary considerably from year to year. Turtles have evolved a strategy to offset episodic impacts to hatchling productivity by laying large numbers of eggs, and distributing their nests both spatially and temporally. Thus, rarely is the total annual reproductive output affected by a storm that impacts a nesting beach. However, chronic erosion exacerbated by human activities along the coastline can result in a permanent reduction in both the quantity and quality of available nesting habitat leading to long-term impacts to hatchling productivity.

During erosion events, nests deposited closest to the water's edge may be completely washed out. Nests incubating higher on the beach can be uncovered or inundated with seawater during unusually high tides, both of which can reduce reproductive success. Accretion of sand above incubating nests may also result in egg and hatchling mortality. Ehrhart and Witherington (1987) reported that 17.5 percent of the loggerhead nests deposited in their Brevard County study area did not emerge due to erosion, accretion, and storm surge. No data are available to assess the effects of erosion and wave overwash on turtle nests in Indian River County.

Nests that are not washed out of the beach may suffer reduced reproductive success as the result of tidal inundation. Eggs saturated with seawater are particularly susceptible to embryonic mortality (Bustard and Greenham 1968, Milton *et al*. 1994, Martin 1996). Accretion of sand above incubating nests may also result in egg and hatchling mortality. Although occasional overwash of nests on Hutchinson Island, Florida appeared to have minimal effect on reproductive success, prolonged or repeated exposure resulted in fewer emergent hatchlings (Ernest and Martin 1993).

3.3.3.1.3 Erosion and Other Activities Related to Man-made Inlets

Work and Dean (1990) estimate that on the east coast of Florida, 85 percent of beach erosion is due to inlet navigational entrances, especially those stabilized by jetties. In Indian River County, Cubit Engineering (1988) calculated that, minimally, the erosive effects of Sebastian Inlet adversely impacted the northern-most eight (8) miles of the

County. However, others have suggested that the impacts may be far greater. The Sebastian Inlet Tax District has implemented a sand bypassing program to reduce the amount of erosion on downdrift beaches. Sediments removed from a catch basin inside the inlet are periodically dredged and deposted on the beach immediately south of the inlet.

Reduced nesting typically occurs near inlets. Although the exact cause(s) is not clear, this phenomenon has been observed all along Florida's east coast (B. Witherington, Florida Marine Research Institute, personal communication, 2000). On Hutchinson Island, for example, where nesting is documented within 1 km (0.62 mile) segments of beach, nesting in the section of beach immediately south of the Ft. Pierce Inlet is the lowest of any survey segment on the island (ABI 1991). Nesting then increases steadily in a southern direction away from the inlet.

In addition to reducing the amount of available nesting habitat, the erosion caused by inlets has the potential to impact turtles in other ways as well. On eroded sections of beach, escarpments and toppled trees can pose obstacles to nesting turtles, preventing them from using what little habitat might otherwise be available. Nests deposited in areas subject to frequent overwash typically experience reduced reproductive success. Collectively, these factors reduce the reproductive potential of a beach.

Although the sand bypassing effort at Sebastian Inlet has the potential to offset erosion effects by increasing the quantity of available nesting habitat, it can affect the reproductive process in other ways. Several researchers have evaluated the effects of the SITD's sand bypassing program on sea turtle reproductive success. The first of those studies detected no significant differences in hatchling emergence success between the beach receiving bypassed sand and a control beach farther south (Ryder 1993). However, in a subsequent investigation, Herren (1999) found a significant reduction in hatchling emergence success on the nourished beaches compared to a control. Differences in results between studies probably relates to the characteristics of the sediments placed on the beach. Sometimes, sand placed on the feeder beach south is dredged from the catch basin inside the inlet, while other times it is trucked in from upland sources.

In addition to impacts on reproductive success, Herren (1999) also noted a decline in nesting success south of the inlet during the first year or two following a sand bypass project. Scarps forming on the beach after project construction led to reduced nesting.

3.3.3.1.4 Coastal Armoring

Seawalls, rock revetments and other types of armoring structures are constructed to prevent both landward retreat of the shoreline and inundation or loss of upland property by wave action or flooding (Kraus and McDougal 1996). Although these structures are generally effective in protecting beachfront property, they do little to promote or maintain sandy beaches.

Over 21percent (145 miles) of Florida's beaches are armored (NMFS and USFWS 1991a and b). By comparison, the Applicant reports that there are presently 34 permanent armoring structures in Indian River County, collectively encompassing slightly more than 1 mile of shoreline. Thus, about 5 percent of the County's coastline is presently armored. About 30 percent of that construction was initiated under the County's emergency permitting authority. The remainder was permitted through FDEP's standard permitting process. Permanent structures along IRC's coastline consist of rock revetments, geotextile bags, wooden retaining walls, and steel, aluminum and concrete seawalls. The majority of armoring (56.5 percent of affected shoreline) is located in the City of Vero Beach.

IRC issued the first emergency permit in 1996. A total of six (6) emergency permits, encompassing 20 upland structures have been issued. Although the permits issued by Indian River County only allow for the implementation of temporary shoreline protection measures, permittees have the right to petition FDEP to erect permanent structures on their property. Four (4) of the emergency permits (protecting 13 structures) issued by the County resulted in permanent structures on the beach, and FDEP permits for the remaining seven (7) structures are pending the outcome of the County's application for an ITP. Thus, based on recent history, temporary shoreline protection measures implemented under an emergency permit from Indian River County have always resulted in permanent structures on the beach.

Armoring structures have the potential to affect natural shoreline processes and the physical beach environment. However, current scientific understanding on these effects is incomplete. It is clear that seawalls prevent long-term recovery of the beach/dune system (i.e. building of the back beach) by physically prohibiting dune formation by wave uprush and wind-blown sand. However, reported topographic effects seaward and adjacent to seawalls often vary and conflict between project sites (Kaufman and Pilkey 1979, Pilkey *et al.* 1984, Kraus 1988, Kraus and McDougal 1996). Much of the controversy surrounding these effects can be attributed to the difficulty in distinguishing between what Pilkey and Wright (1988) term "passive" and "active" erosion. Passive erosion relates to the natural tendencies of the shoreline (e.g., erosion or accretion) at a site prior to the presence of a seawall. Active erosion results from the interaction of the wall with local coastal processes.

Erosion of adjacent downdrift beaches can occur if the updrift wall acts as a jetty and impounds sand (Kraus 1988, Tait and Griggs 1990). Additionally, seawalls can cause wave reflection and scour, processes that accelerate erosion seaward of the structure and steepen the offshore profile (Pilkey *et al.* 1984). Sand can move alongshore past a seawall, but it is not clear if the longshore sediment transport rate changes (Kraus and McDougal 1996). Pilkey *et al.* (1984) contend that the intensity of longshore currents does increase in front of seawalls and this hastens removal of beach sand. Most likely, the extent to which any of these potentially harmful effects may be realized is largely dependent upon a structure's physical position on the beach relative to the surf zone (Kraus 1988, Tait and Griggs 1990). The closer a seawall is to the surf zone, the greater its potential for altering shoreline processes.

Considerable anecdotal information exists to suggest that permanent armoring structures can diminish the quality of sea turtle nesting habitat. However, there have been few experimental studies designed specifically to assess the impacts of these structures on sea turtle nesting. Mosier (1998) and Mosier and Witherington (In Press) recorded the behavior of nesting turtles in front of seawalls and adjacent unarmored sections of beach. Because their study sites were located in Brevard and Indian River Counties, their findings are directly applicable to assessment of impacts associated with the Applicant's proposed activities. Both studies reported that fewer female sea turtles crawled out of the surf onto beaches fronted by seawalls than on beaches where similar structures were absent. Of those turtles that did emerge in the presence of seawalls, proportionally fewer nested. Additionally, turtles on armored sections of beach tended to wander greater distances than those that emerged on adjacent natural beaches. This additional energy expenditure may reduce total annual egg production, however, no empirical studies have been conducted to quantify this effect.

Studies by Mosier (1998) and Mosier and Witherington (In Press) demonstrate that seawalls create sub-optimal nesting habitat and incubation environments for sea turtles. Seawalls can effectively eliminate a turtle's access to upper regions of the beach/dune system. Consequently, nests on armored beaches in Brevard and Indian River Counties were generally found at lower elevations than those on non-walled beaches. Lower elevations subject nests to a greater risk of tidal inundation and can potentially alter thermal regimes, an important factor in determining the sex ratio of hatchlings (Mrosovsky and Provancha 1989, Mrosovsky 1994, Ackerman 1997, Delpech and Foote 1998).

High tides frequently reach the base of armoring structures, particularly during spring tides and storm events. Thus, nests deposited in front of these structures are often subject to tidal inundation. For this reason, nests on some armored nesting beaches have to be relocated each year to a more suitable incubation environment (EAI 2001b). The negative effects of seawalls become more pronounced the closer the seawalls are to the surf zone. Thus, the quality of beach habitat seaward of armoring structures on eroding sections of coastline can be expected to diminish as the shoreline recedes.

In addition to those effects discussed above, impacts can occur if the installation of structures takes place during the sea turtle nesting season. Unmarked nests can be crushed or unearthed by heavy equipment. Vibrations and water runoff from jetting operations during installation of structures can also damage nests. There have also been reported incidents of nesting turtles and hatchlings caught in construction debris or trapped in excavations at the construction site.

Once a structure is in place, it can continue to cause problems for sea turtles (FWC, unpublished data). For example, hatchlings have been trapped in holes or crevices of exposed riprap and geotextile tubes. Both nesting turtles and hatchlings have been entangled or entrapped in the debris of failed structures. There have also been

reports of injuries to nesting turtles that have been able to climb onto a seawall via adjacent properties and have subsequently fallen off.

As the extent of armoring on beaches increases, the probability of a nesting turtle encountering a seawall or depositing a nest in sub-optimal habitat increases. Additionally, the displacement of nests from armored locations may increase the density of nests in a dwindling number of suitable nesting sites thereby increasing the potential for density-dependant nest mortality (e.g., turtles digging up existing nests).

3.3.3.1.5 Beach Nourishment

Due to the uncertainty regarding the effects of armoring structures on the beach ecosystem, beach nourishment has received preferential treatment as a means for combating erosion and providing shoreline protection. Beach nourishment typically involves the dredging of sand from inlets or offshore "borrow" areas and placing it on an eroded section of coastline. Inland sand sources may also be used. State and County rules require that the introduced material be of compatible and comparable physical nature to the native sands it replaces.

Indian River County's Beach Preservation Plan currently proposes four major beach nourishment projects, encompassing 8.3 miles of beach, or 37 percent of the County's coastline (IRC 1998b). The projects are scheduled to commence in 2002 and will be phased in over a four-year period. Once each project has been built, it will be replenished at approximately 8-year intervals over the next 30 years.

Although beach nourishment is generally viewed as a more environmentally benign solution to shoreline protection than armoring, it too has potential for impacting sea turtles. It can affect the sea turtle reproductive process in a variety of ways. Although nourished beaches may provide a greater quantity of nesting habitat, the quality of that habitat may be less suitable than pre-existing natural beaches. Sub-optimal nesting habitat may decrease nesting, place an increased energy burden on nesting females, result in abnormal nest construction, and reduce the survivorship of eggs and hatchlings. A thorough review of the processes associated with each of these potential effects was presented by Crain *et al.* (1995).

Most nourishment projects on heavily nested beaches are planned so construction occurs outside of the main portion of the nesting season to minimize take of turtles. Nevertheless construction impacts can occur. Unmarked nests may be crushed by construction equipment or buried during deposition of dredged materials on the beach. Nests relocated out of harm's way may experience reduced reproductive success (Moody 1998).

Nourished beaches tend to differ in several important ways from natural beaches. They are typically wider, flatter, more compact, and the sediments are moister than those on natural beaches (Ackerman *et al.* 1991, Nelson *et al.* 1987, Ernest and Martin 1999). On severely eroded sections of beach, where little or no suitable nesting habitat

previously existed, nourishment can result in increased nesting (Ernest and Martin 1999). However, on most beaches, nesting success typically declines for the first one or two years following construction, even though more habitat is available for turtles (Trindell *et al.* 1998). Reduced nesting success on nourished beaches has been attributed to increased compaction of sediments, scarping, and changes in beach profile (Nelson *et al.* 1987, Crain *et al.* 1995, Davis *et al.* 1994, Lutcavage *et al.* 1997, Steinitz *et al.* 1998, Ernest and Martin 1999). Compaction presumably inhibits nest construction, while scarps often cause female turtles to return to the ocean without nesting or deposit their nests seaward of the scarp where they are more susceptible to tidal inundation.

On Jupiter Island, Florida, nesting patterns reportedly cycle over the life of a nourished beach (Steinitz *et al.* 1998). Prior to nourishment, when the beaches are badly eroded, nesting is relatively low. After project construction, more turtles emerge onto the beach but nesting success is relatively low. As the beaches are reworked by natural processes in subsequent years, sediment compaction and the frequency of scarps decline, and nesting and nesting success return to levels similar to those found on natural beaches. As erosion eventually returns the beach to its pre-nourishment condition, nest densities once again decline and the cycle is repeated.

Beach nourishment can affect the incubation environment of nests by altering the moisture content, gas exchange, and temperature of sediments (Ackerman *et al.* 1991, Ackerman 1997, Parkinson and Magron 1998). The extent to which the incubation environment is altered is largely dependent on the similarity of the nourished sands and the natural sediments they replace. Consequently results of studies assessing the effects of nourishment on reproductive success have varied among study sites.

Even though nourished beaches are wider, nests deposited there may experience higher rates of wash out than those on relatively narrow, steeply sloped beaches (Ernest and Martin 1999). This occurs because nests on nourished beaches are more broadly distributed than those on natural beaches, where they tend to be clustered near the base of the dune. Nests laid closest to the waterline on nourished beaches may be lost during the first one or two years following construction, as the beach experiences an equilibration process during which seaward portions of the beach are lost to erosion. Increased nest loss due to erosion may reduce the productivity of nourished beaches as sea turtle nesting habitat.

Take of sea turtles associated with beach nourishment projects is authorized under the Federal permits issued for such projects. Minimization of impacts is established during consultations among Federal agencies as stipulated in Section 7 of the ESA. Consequently, environmental impacts associated with beach nourishment projects undertaken by the Indian River County are not addressed as part of the Applicant's HCP.

3.3.3.1.6 Other Types of Coastal Construction

In addition to coastal armoring and beach nourishment, there are a variety of other types of coastal construction activities, each of which may affect sea turtles. Many of these activities are related to shoreline protection, including the placement of sand from

other sources on the beach, installation of sand bags, dune restoration, and the construction of jetties and groins. Any of these activities may result in both construction and post-construction impacts similar to those described for armoring and beach nourishment. Construction impacts can be largely avoided if the activities are undertaken outside of the nesting season. The construction of dune crossovers, when performed during the nesting season, can cause mechanical damage to unmarked sea turtle nests.

3.3.3.1.7 Artificial Beachfront Lighting

Both nesting and hatchling sea turtles are adversely affected by the presence of artificial lights near the beach (Witherington and Martin 2000). Experimental studies have clearly demonstrated that bright lights can deter adult female turtles from emerging from the ocean to nest (Witherington 1992). Thus, not surprisingly, many researchers have noted a relationship between the amount of lighted beach development and sea turtle nest densities. For example, Mattison *et al.* (1993) noted that emergences of nesting turtles in Broward County, Florida were reduced in areas where lighted piers and roadways were near the beach. In areas where a glow of artificial light is present behind the dune, loggerhead turtles prefer to nest in the darker areas silhouetted by tall buildings and dune vegetation (Salmon *et al.* 1995).

Although there is a tendency for turtles to prefer dark beaches, many do nest on lighted shores. As noted by Witherington and Martin (2000), in doing so, they place the lives of their hatchlings at risk. That is because artificial lighting can impair the ability of hatchlings to properly orient to the ocean once they leave their nests.

Hatchling sea turtles exhibit a robust sea-finding behavior. A direct and timely migration from the nest to sea may be vital to their survivorship. Although the cues involved in sea finding are complex, hatchlings rely primarily on vision for proper orientation (Witherington and Martin 2000, Salmon *et al.* 1992, Lohmann *et al.* 1997). A combination of light and shapes is thought to be responsible. The extent to which one or the other drives the process may be a function of the relative strength of each stimulus.

Hatchlings have a tendency to orient toward the brightest direction. On natural undeveloped beaches the brightest direction is almost always away from elevated shapes (e.g., dune, vegetation, etc.) and their silhouettes and toward the broad open horizon of the sea. On developed beaches, the brightest direction is often away from the ocean and toward lighted structures. Hatchlings unable to find the ocean, or delayed in reaching it, are likely to incur high mortality from dehydration, exhaustion, or predation (Carr and Ogren 1960, Witherington and Ehrhart 1987, Witherinton and Martin 2000). Hatchlings lured into lighted parking lots or toward street lights are often crushed by passing vehicles (McFarlane 1963, Philibosian 1976, Peters and Verhoeven 1994, Witherington and Martin 2000).

To reduce the harmful effects of artificial beachfront lighting, many communities have adopted lighting regulations. Indian River County's Sea Turtle Protection Ordinance prohibits illumination of the beach during the sea turtle nesting season (March

1 through October 31) of each year (IRC 1998a). The County also requires a beachfront lighting evaluation before issuing Certificates of Occupancy for new construction.

3.3.3.1.8 Vehicles

The public is not permitted to operate motorized vehicles on the beaches of Indian River County. However, public safety vehicles may occasionally access the beach for emergency situations and maintenance vehicles may be called upon to remove debris from the beach if it poses a public safety hazard (e.g., following storm events). If vehicles are on the beach during the sea turtle nesting season, they may run over nests. Nighttime operations could potentially result in direct take of adult and hatchling sea turtles. Additionally, the ruts left by vehicles in the soft sand may prevent or impede hatchlings from reaching the ocean following their emergence from the nest.

Most public safety operations in Indian River County, primarily by the County Sheriff's Office, involve the use of all-terrain vehicles (ATVs). These lightweight vehicles have wide, low-pressure tires that minimize the potential for impacts to unmarked turtle nests.

In 1998, the Town of Indian River Shores constructed a ramp to allow public safety vehicles access to the beach for routine patrols and emergency operations. As a condition of the FDEP permit for the construction of the ramp, the Town was required to use lightweight, all-terrain vehicles (ATVs) having wide, low-pressure tires. Additionally, a sea turtle monitoring program was implemented to assess the impacts of routine beach operations.

3.3.3.1.9 Recreational Equipment

The use and storage of lounge chairs, cabanas, umbrellas, hobie cats, and other types of recreational equipment on nesting beaches can hamper or deter nesting by adult females and trap and/or impede hatchlings during their nest to sea migrations. The recovery plan for Atlantic loggerhead turtles (NMFS and USFWS 1991a) indicates that "the documentation of false crawls at these obstacles is becoming increasingly common as more recreational beach equipment is left in place nightly on nesting beaches." The recovery plan cites documented reports of adult turtles being trapped under heavy wooden lounge chairs, eggs being destroyed by equipment (e.g., beach umbrellas) penetrating the egg chamber, and hatchlings being hampered during emergence by equipment inadvertently placed on top of the nest. The extent to which recreational equipment is impacting turtles in Indian River County is presently unknown.

3.3.3.1.10 Stormwater Drainage and Pool Discharges

In areas where seawalled commercial properties front the ocean, stormwater discharge is sometimes diverted onto the beach where it can undermine nests. Beach discharges from pools can have similar consequences. The extent to which these factors affect sea turtles in Indian River County is currently unknown. The area most likely

impacted would be in the City of Vero Beach where armoring is heaviest and numerous hotels/motels and commercial establishments abut the beach.

3.3.3.2 Migratory Birds

The beach environment within the Plan Area provides potential nesting, foraging, and resting habitat for various species of migratory shorebirds. These birds may be impacted by shoreline protection measures initiated under the Applicant's emergency authorization.

Both natural and anthropogenic factors may affect migratory birds within the Plan Area. Beach erosion reduces the amount of potential bird nesting habitat, and predators, such as raccoons and foxes, prey on eggs and chicks of ground-nesting species. Principal anthropogenic impacts include habitat loss due to beachfront development and disturbances to nesting, foraging, and resting activities caused by beachgoers, free-roaming domestic cats and dogs, and mechanical equipment on the beach. Relevant to the Applicant's HCP are impacts associated with construction during implementation of shoreline protection measures and alteration of habitat associated with the placement of permanent armoring structures on the beach.

Colonial nesting shorebirds are particularly sensitive to disturbance. Although nesting shorebirds can habituate themselves to limited human activities (Brubeck *et al*. 1981), chronic disturbances can have more serious consequences. Some evidence suggests that persistent disturbances can result in decreased reproductive success and even abandonment of a nesting colony (Fisk 1978, Gaddy 1982, Gochfeld 1983). Nesting terns, for example, will often mob perceived threats to their nest sites (e.g., nearby pedestrian or vehicular traffic), thereby increasing energy expenditures and leaving their eggs vulnerable to overheating or predation (Gaddy 1982). Actual intrusion into a nesting colony by pedestrian or vehicular traffic can unintentionally cause direct harm to eggs (e.g., crushing) and young.

Feeding and resting migratory birds may be temporarily affected during construction by the movement of people and equipment within a project area. Noise and vibration associated with construction activities may also frighten birds on adjacent properties. Upon approach, shorebirds will evade perceived threats by taking to the air in search of areas that appear free from disturbance. Certain species are more sensitive to disturbance than others, and thus may take flight more often or otherwise change their behavior in response to activities on the beach. Repeated disturbances may decrease energy reserves and disrupt feeding thereby reducing survivorship during long-distance migrations. For example, some studies indicate that human disturbance reduces the amount of time that piping plovers spend feeding (Johnson and Baldassare 1988, Haig 1992). However, studies to quantify these impacts on survivorship are largely lacking.

Permanent coastal armoring structures may alter physical beach characteristics and increase erosion on beaches both adjacent to and downdrift of the structures. These changes may affect the quality of habitat available to migratory shorebirds.

Mortality of birds, their eggs and chicks, and destruction of nests is unlikely to occur as the result of Service issuance of an ITP. Most birds will take flight upon approach of humans. Although eggs and chicks might be unable to avoid direct impacts, it is unlikely that any would be present in the highly eroded environment that would initiate emergency shoreline protection activities. The primary impact from the Applicant's proposed activities will be the flushing of migratory birds during construction and alteration of potential nesting and resting habitat related to permanent armoring structures along the beach.

3.4 Cultural Resources

The National Historic Preservation Act (16 USC Section 470) of 1966, as amended, calls for the preservation of historic and cultural properties so that sites of cultural heritage will be maintained and enriched for future generations of Americans. There are numerous cultural and historic landmarks in the coastal environment of IRC. The location of known resources was determined by a search of the Florida Master Site File maintained by the Florida Department of State, Division of Historical Resources, Bureau of Archaeological Research. This GIS database denotes the general location of standing historical structures and archaeological resources.

The State's GIS database indicated the presence of Indian shell middens, shipwrecks, and buildings from the early 1900's. The middens are ancient refuse heaps containing shells, charcoal, and food remains left from IRC's earliest human inhabitants. Most of the middens were shown west of A1A, but a few sites were indicated on the beach/dune system and adjacent upland properties. However these were limited primarily to the northern end of the County, where there is little development. Indian River County's Chief of Environmental Planning & Code Enforcement reviewed the County's local archaeological survey and concluded, that although the entire barrier island has been designated as a "predicted or demonstrated high site density" with respect to archaeological resources, most of the documented sites are on the west side of the island near the Indian River Lagoon .

Historic buildings built in the early 1900's are found in the City of Vero Beach. Most are privately owned and west of A1A. Only two were located on oceanfront land, and both are protected by existing seawalls.

Twelve (12) historic shipwrecks of Spanish, French, and British origin are known to exist along the east coast of IRC (IRC 1998a). Most are located well offshore seaward of the Plan Area. However, a few sites, consisting of artifact-scatter, are present along the shoreline or in shallow nearshore areas.

Based on a review of the Florida Master Site File and the information provided by the County's Chief Environmental Officer, the State Historic Preservation Officer rendered an opinion as to the potential effects of the Applicant's proposed action. It was concluded that no historic properties will be affected by emergency shoreline protection activities (Attachment B).

3.5 Social Interests

The beaches of Indian River County represent a major recreational asset and impart a distinctive character to the community. Over 100,000 people reside in the County and 90 percent of those residents live within 10 miles of the beach (IRC 1998a). Surveys found that about 41 percent of all beach users in IRC were County residents (ATM 1998). Most people (88 percent) visit the beach for the purpose of swimming and/or sunbathing. However, walking/jogging, shelling, surfing and fishing are also frequent activities.

County Beaches attract thousands of tourists each year. Tourism is IRC's primary industry and the beaches are the number one tourist destination (ATM 1999). The warm climate provides for year-round beach use.

Access to the beach is provided through municipal, County, State and Federal parks. Over 1,000 parking spaces are contained in these parks scattered along the length of the County's coastline (IRC 1998a). Oceanfront property owners and transient residents of oceanfront hotels/motels access the beach via established dune crossovers adjacent to their facilities.

The importance of beaches to tourism coupled with the high beach usage by local residents prompted Indian River County to develop a Beach Preservation Plan. The BPP calls for the nourishment of approximately 8.3 miles of eroded shoreline. Despite on-going maintenance costs, beach nourishment has been characterized as a "viable alternative for providing shore protection and for restoring lost recreational beach assets" (National Research Council 1995).

Not only do eroded beaches detract from the Applicant's economic base, but they may also pose risks to public safety. High dune escarpments make access to and from the water dangerous, and undermined dune crossovers may collapse. Seawalls along severely eroded sections of beach may prevent or restrict shore-parallel movement of beach users at high tide and can be dangerous to traverse (Pilkey and Dixon 1996). Chapter 62B-33, FAC, Rules and Procedures for Coastal Construction, requires that armoring structures be constructed in such a manner as not to preclude public access without provision for alternative access.

3.6 Economy

The total appraised value of barrier island properties in 1998 was approximately $2.9 billion (ATM 1999), representing 35.7 percent of the total value of all properties within the County. Because of the disproportionate contribution of oceanfront properties to the local tax base, the County, as well as property owners, have a vested interest in preserving real estate values.

County Beaches are also a tremendous recreational asset. Through tourist-related industries and beach use by local residents, it is estimated that County Beaches have a recreational benefit of $3.66 million annually (ATM 1999). This value can only be expected to increase as both the population and tourist base grow. Consequently, the restoration and preservation of recreational beach assets is a high priority for the County.

Narrow beaches bordered by seawalls detract from the value of local beaches. Indian River County's Beach Preservation Plan is intended to restore lost recreational values by widening the beaches along critically eroded sections of coastline. The projected cost of the fully-implemented, 30-year BPP is $33.9 million (ATM 1999). It is projected to result in $102.8 million in storm protection and recreational use benefits, representing a 3.0:1 benefit to cost ratio.

3.7 Aesthetics

Sandy beaches naturally attract people to the shoreline. Commercial establishments along the ocean, such as hotels and restaurants, are popular destinations. In general, natural shorelines with vegetated dunes add to the beach experience, while beaches fronted by seawalls and other types of armoring structures are much less appealing (Pilkey and Dixon 1996).

4.0 ENVIRONMENTAL CONSEQUENCES

The purpose of this section is to discuss the consequences of each of the alternatives described in Section 2.0 above. Components of the natural and human environment potentially affected by one or more of the alternatives were described in Section 3. Analyses of both direct and indirect effects, as well as cumulative impacts, are included in the evaluation of each alternative. Direct effects are those that occur immediately or directly as a result of the proposed action. Indirect effects are those "which are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable" (40 CFR 1508.8). Cumulative impacts are the sum of the incremental impacts of past, present, and reasonably foreseeable future actions (40 CFR 1508.7).

The Service believes that Indian River County's Comp Plan sufficiently addresses existing and anticipated future effects of urban growth and coastal development on natural and human environments. That document provides a 20-year planning and growth management outlook that identifies current and projected future impacts on the environment and describes measures that will be undertaken by the Applicant to minimize those impacts. Additionally, the Applicant has developed and is in the process of implementing a Beach Preservation Plan, a 30-year program to restore and maintain the recreational, economic, and environmental values of its beaches through systematic beach nourishment and dune restoration projects. All of the elements of the human environment identified under NEPA and not specifically included below are adequately addressed in IRC's Comp Plan. Thus, further analyses of elements unaffected by any of the alternatives would be redundant.

4.1 Alternative 1: The No Action Alternative

Under the No Action Alternative, the Service would not issue an ITP to Indian River County, and the take of sea turtles incidental to shoreline protection measures initiated under the Applicant's emergency permitting authority would not be authorized. As a result of this action, the Applicant might either relinquish local emergency permitting authority to the State of Florida or continue to issue emergency shoreline protection permits without the benefit of protection for take as afforded under Section 10 of the ESA. Similarly, the State of Florida could resume issuance of emergency permits with or without Section 10 ESA protection for take.

For the purpose of this analysis it is assumed that in the absence of an ITP, the Applicant would discontinue issuance of emergency shoreline protection permits and the State would resume emergency permitting. Although there are slight differences in State rules and procedures governing emergency shoreline protection and those proposed by the Applicant, environmental impacts associated with State issuance of emergency permits would be essentially the same as those described under the Preferred Alternative. This holds true whether or not the State sought a Section 10 ITP, with the exception that

without an ITP, the benefits of mitigation would be lacking. Thus, when evaluating environmental consequences of the No Action Alternative, the principal issue is the absence of a local response to emergency conditions.

4.1.1 Physical Environment

Florida's east coast barrier island beaches are extremely dynamic, and over extended periods they naturally migrate (Pilkey *et al.* 1984). However, despite the erosion that typically occurs along the eastern shoreline, there is sufficient sand within the nearshore system to ensure that sandy beaches will always be present. The problem arises when beachfront properties are developed in an inappropriate manner and natural shoreline processes are interrupted. When properties become threatened by erosion, armoring structures are often erected. Although these structures afford protection to upland properties, they can interfere with the longshore transport of sand and thereby impact adjacent beaches. Thus, the effect of armoring structures on the physical environment is an alteration of natural shoreline characteristics.

In assessing the direct impacts of the No Action Alternative on the physical environment, the question to be considered is whether or not this alternative would affect the number of erosion control structures built along IRC's coastline. Beachfront homes and other habitable buildings constructed prior to establishment of Florida's CCCL Rules are eligible for erosion control structures, provided they can demonstrate that the property is vulnerable to erosion.

Seawalls and other types of armoring structures can be built in Florida under either a standard or emergency permit (Section 161, FS, and Chapter 62B-33, FAC). The State has delegated emergency permitting authority to Indian River County, and the Applicant is only requesting authorization for take resulting from shoreline protection measures initiated under its emergency authorization. If the County does not receive a Service ITP and ceases to issue emergency shoreline protection permits, owners of eligible structures would still be able to petition the State of Florida for such permits. Insofar as the County used the State's dune erosion model to determine vulnerability (Appendix C of the Applicant's HCP), it would seem likely that a structure determined to be eligible for a shoreline protection permit under the County's emergency permitting authority would also be eligible for a State permit. Furthermore, State and local rules governing emergency shoreline protection measures are essentially the same, and approval of a permanent structure at a site where shoreline protection was initiated under emergency authorization would rest with the State, regardless of who issued the emergency permit. Consequently, there would not appear to be any substantial difference in the types of shoreline protection activities allowed on the beach or in the number of permanent structures erected in Indian River County with or without Service issuance of an ITP.

4.1.2 Land Use

Shoreline erosion has no relation to zoning or other County land-use classifications. Land use patterns would only be affected if erosion were so severe that existing structures were rendered uninhabitable. This could affect property values and could result in changes in ownership. However, insofar as emergency shoreline protection activities can be permitted by the State of Florida in the absence of local permitting authority, the No Action Alternative would have no direct or indirect effect on land use.

4.1.3 Biological Environment

With the exception of sea turtles, and possibly migratory shorebirds, implementation of the No Action Alternative is not expected to have any direct, indirect or cumulative impacts on the biological environment. The only properties that would be affected by the ITP are those that are already developed and are fronted by an eroding shoreline. Remaining native plant communities on these properties have been substantially altered. Thus, they would not be expected to provide suitable habitat for those terrestrial protected species (e.g., southeastern beach mouse, indigo snake, wood stork) likely to occur within the Plan Area.

All methods of shoreline protection have the potential to cause take of sea turtles by disrupting behavior patterns and/or diminishing the quality of nesting habitat. Migratory shorebirds may be harassed by movement, noise, and/or vibration of humans and equipment during construction activities, and the quality of available nesting and resting habitat may be affected by changes in the physical character of the beach following installation of armoring structures. Under the No Action Alternative, residents of Indian River County would not be able to initiate emergency shoreline protection activities under the Applicant's authorization. However, they would still be eligible for emergency permits through the State of Florida. They could also petition the State for authorization to place permanent shoreline protection structures on the beach. Thus, the impacts to turtles and migratory birds would largely be the same whether or not the Service issues an ITP. However, the conservation benefits to sea turtles from mitigation measures proposed by the Applicant would be absent under the No Action Alternative. Thus, the reproductive success of turtles nesting on County Beaches would be considerably greater under the Preferred Alternative than under the No Action Alternative. No other federally protected species are likely to be impacted by any of the alternatives considered in this EA.

4.1.4 Cultural Resources

The No Action Alternative is not anticipated to have any direct effect on standing historical structures, as seawalls already protect the only two historic buildings near the beach. Additionally, Florida's State Historic Preservation Officer has concluded that no significant archaeological resources are likely to be affected by emergency shoreline

protection activities (Attachment B). Even if historic properties were threatened by erosion, emergency permitting can be obtained through the State of Florida. Thus, the Service's determination to issue or not to issue an ITP to Indian River County has no effect on the County's cultural resources.

4.1.5 Social Issues

One of the principal reasons that Indian River County assumed emergency permitting authority from the State was because it felt it could provide its citizens with a more timely and effective response to severe erosion conditions following major storm events. Presumably, the County's Coastal Engineer is most familiar with the natural processes affecting localized erosion and therefore should be in the best position to assess alternative actions and develop appropriate responses. If, in the absence of local permitting authority, shoreline protection measures authorized by the State are either ineffective or are not implemented in a timely manner, habitable structures could be damaged or lost. Furthermore, damaged structures and debris on the beach could pose human safety risks. Thus, the No Action Alternative could result in a higher level of impact to the citizens of Indian River County than the Preferred Alternative.

Implementation of the No Action Alternative would have no perceivable influence on beach access or beach use activities. Indian River County would continue with its plans to restore and maintain recreational beach values through its long-term beach nourishment and dune enhancement program.

4.1.6 Economic Concerns

As indicated above, the Indian River County's forfeiture of emergency permitting authority could lead to less timely and/or effective erosion control measures. Thus, the No Action Alternative may result in increased property damage. This, in turn, could result in a decline in property values and a decrease in the County's tax base. The Applicant projects that 31 structures are likely to be vulnerable to erosion over the 30-year life of the ITP. The current estimated net worth of those structures reportedly exceeds 11 million dollars (ATM 1999). Each structure along the beach damaged or destroyed by a storm will result in realized insurance losses, including costs for repair or replacement. If structures are abandoned due to storm damage, the County's tax base is diminished. Debris on the beach must be removed at County expense. Additionally, the County may face legal action if, after having assumed local emergency permitting authority, it refuses to allow its citizens to protect eligible structures in the aftermath of a severe storm and damage results as a consequence.

4.1.7 Aesthetics

The No Action Alternative is not expected to appreciably affect the overall aesthetics of the coastline. Although it seems reasonable to argue that most beachgoers prefer a natural shoreline to one fronted by bulkheads and seawalls, the Service has no reason to conclude that fewer permanent armoring structures would be built under the No Action Alternative than under the Preferred Alternative. In fact, in the short-term, the

lack of a timely and effective response to severe erosion threats via local emergency permitting authority could result in a greater potential for damage to beachfront buildings. Damaged structures and unsightly debris on the beach would detract from the scenic values to which most beachgoers are accustomed.

4.2 Alternative 2: Issuance of the ITP in Conjunction With Shoreline Protection Measures Contained in IRC's Beach Preservation Plan (The Preferred Alternative)

The Preferred Alternative is Service issuance of a Section 10(a)(1)(B) permit to allow for the take of sea turtles, over a 30-year period, incidental to shoreline protection measures initiated under Indian River County's emergency permitting authority. The Applicant has developed criteria to avoid and minimize take as much as practicable and would implement mitigation measures in excess of the amount of take estimated to occur as a result of the proposed action.

The Applicant would implement emergency shoreline protection measures as part of its long-range Beach Preservation Plan, which includes four separate beach nourishment projects. Vulnerable habitable structures would not be eligible for seawalls or other permanent shoreline protection measures if a beach nourishment, sand transfer or similar project providing enhanced protection for the beach/dune system is scheduled for construction within nine months of the time an application for the seawall is made to FDEP.

4.2.1 Physical Environment

The applicant has attempted to minimize the potential for damage to the physical environment through its emergency permitting criteria. Proactive planning will be initiated to reduce the future need for emergency measures on eroding sections of coastline. Additionally, evaluations of vulnerable properties will be conducted by the County's Coastal Engineer following a storm event to ensure that shoreline protection measures are only initiated where they are warranted and that the protective measure(s) utilized will have as little impact as possible on sea turtles and their habitat, while providing adequate protection to the vulnerable structure. Soft solutions, such as the placement of beach-compatible sand seaward of the structure and sand bags, shall be utilized whenever possible, while temporary hard solutions, such as wooden retaining walls, cantilever sheetpile walls and similar structures, will only be permitted when soft solutions cannot reasonably be expected to provide adequate protection for the vulnerable structure. Soft stabilization techniques have less potential for altering natural shoreline processes than hard techniques.

Despite these precautions, the direct physical effect of the Preferred Alternative could ultimately result in the armoring of nearly 0.61 miles of beach or 2.7 percent of the County's coastline. This would add to the 1.08 miles of existing armoring, and thus the cumulative effect would be 1.69 miles, or 7.6 percent, of the County's coastline.

In the absence of armoring structures, the shoreline is allowed to migrate naturally. However, along eroding sections of coastline, beach/dune recession can only occur as far landward as the armoring structure. Over time, the distance between the structure and the surf zone decreases and its interaction with coastal processes becomes more pronounced. If the structure juts into the intertidal zone, it will function as a groin or jetty. This may cause a sand deficit on the downdrift side of the structure. As the amount of armoring on the beach increases, the potential for disrupting natural shoreline processes also increases.

Although armoring structures placed on and near the beach could have the potential to alter the physical environment within the Plan Area, the Preferred Alternative may not result in any greater impacts than the No Action Alternative, because structures could still be protected through FDEP permitting.

4.2.2 Land Use

Shoreline erosion has no relation to zoning or other land-use classifications in Indian River County. Land use patterns would only be affected if erosion were so severe that existing structures were rendered uninhabitable. This could affect property values and result in changes in ownership. The Preferred Alternative could lead to more effective and timely responses to emergency erosion events thereby reducing the likelihood of damage or loss to beachfront properties. However, insofar as emergency shoreline protection activities can also be permitted through the State of Florida, the Preferred Alternative would probably have no direct or indirect effect on land use.

4.2.3 Biological Environment

4.2.3.1 Sea Turtles

Evaluation of incidental take of sea turtles will be difficult to detect due to numerous variables and because recovery of dead or impaired specimens are unlikely and quantification of effects to the population based on displaced nesting females is not feasible.

4.2.3.1.1 Direct Effects

Construction impacts related to emergency shoreline protection projects, as provided in the HCP, may include the following:

- Burial, destruction, or excavation of pre-existing nests, including eggs and hatchlings;
- Hatchlings and/or adults trapped by equipment and excavation hazards on the beach;
- Hatchlings impeded from reaching the ocean after leaving the nest by equipment, materials and holes on the beach and/or vehicle ruts;
- Adults prevented from accessing suitable nesting habitat;

- Reduction in spatial extent of nesting habitat;
- Reduced nesting success; and
- Reduced reproductive success as a result of nest relocation.

4.2.3.1.2 Indirect Effects

Under the Preferred Alternative, the Applicant estimates that 31 eligible structures, encompassing approximately 3,196 linear feet of shoreline (0.61 miles), would likely be vulnerable to storm damage over the 30-year life of the ITP. An analysis of impacts (worse-case scenario) indicates that permanent armoring structures erected at each of these sites during the first year following issuance of the ITP would result in the collective displacement of 1,150 loggerhead, 56 green, and 3 leatherback nests.

Another potential indirect impact associated with armoring is the change in beach profile that often occurs seaward of the structure. Mosier (1998) found that nests deposited on beaches fronted by seawalls were generally at lower elevations than those deposited on adjacent natural beaches. Lower elevations could increase the frequency of wave overwash and/or tidal inundation, both of which can reduce the reproductive success of incubating nests.

The Applicant intends to minimize impacts to sea turtles and their habitat through measures specified in the HCP. Pre-construction evaluations will be performed to ensure that emergency shoreline protection is only initiated where it is warranted and that the actions taken are the minimum required (i.e., least impact to nesting habitat) to protect the structure. A sea turtle monitoring and nest protection program will be required to minimize the likelihood of construction impacts to nesting turtles, nests, and hatchlings. Additionally, criteria have been established for the design and siting of armoring structures to reduce their potential for impacting nesting and hatchling sea turtles.

For the purposes of assessing take, nest displacement was considered a lethal form of take, even though total annual egg production may not be appreciably affected. Through this conservative approach, the Service has compensated for direct impacts to eggs, hatchlings and adults during construction of shoreline protection projects, reduced reproductive success associated with placement of eggs in a sub-optimum incubation environment, and take that may occur if nesting turtles are injured by a structure. There have been a few reports of injuries to nesting turtles that climbed onto seawalls via adjacent properties and subsequently fell off.

Mitigation offered by the Applicant in the HCP includes conservation benefits derived from previously acquired conservation lands and predator control. Together, this mitigation provides a 4.2:1.0 benefit ratio for loggerheads, a 4.0:1.0 ratio for green turtles, and a 3.6:1 ratio for leatherbacks. The projected benefit ratio for leatherback turtles is much smaller, because this species accounts for only a very small percentage of Countywide nesting.

In addition to those quantifiable mitigation measures identified above, the Applicant will implement a pro-active light management program in unincorporated areas of the County, coordinate existing sea turtle monitoring programs, expand monitoring into areas not previously or routinely surveyed, and consolidate nesting data into a Countywide database. By identifying and responding to known sources of human impact, these programs are expected to have additional, although as yet unquantified, conservation benefits for sea turtles.

4.2.3.1.3 Cumulative Effects

Although some impacts to turtles and nests are likely to occur during construction of emergency shoreline protection measures, the principal impact under the Preferred Alternative will be the displacement of turtle nests caused by the permanent placement of armoring structures along as much as 0.61 miles of beach. When added to the existing 1.08 miles of existing armoring, the cumulative effect would be 1.69 miles, or 7.6 percent of the County's coastline. Mosier (1998) demonstrated that the cumulative effects of armoring are not necessarily linear. Thus, as the percentage of armored beach increases, there is a disproportionate decrease in the amount of nesting that occurs there. In severely eroded areas, armoring may completely eliminate nesting.

As the extent of shoreline armoring increases, the likelihood of repeated encounters with armoring structures increases. Murphy (1985) reported that turtles repeatedly deterred from nesting might place their nests in unsuitable areas. Thus, multiple encounters with seawalls might cause a greater percentage of turtles to place their nests in sub-optimum incubation environments. Consequently, the cumulative effect of all armoring, both existing and future, on County Beaches could be a reduction in total annual reproductive output.

When addressing cumulative impacts under NEPA, the Service must consider all past, present, and reasonably foreseeable future actions similar to those proposed by the applicant, including those carried out by the Federal government (40 CFR 1508.7). In addition to the impacts associated with existing armoring noted above, cumulative effects also include those shoreline protection measures occurring as a result of future illegal placement of structures or debris on the beach by property owners and/or permanent structures authorized through the Florida Department of Environmental Protection.

With respect to shoreline armoring, the only Federal action that could contribute to cumulative effects under the Plan would be armoring within the ACNWR. Under State rules (Chapter 62B-33, FAC), future armoring is only permitted to protect habitable structures and public infrastructure and cannot be used to provide erosion control for undeveloped property. Furthermore, armoring is specifically prohibited on public lands within the ACNWR, unless it is necessary to protect public infrastructure and no reasonable alternative exists.

In addition to, and independent of, the Applicant's request for incidental take of sea turtles during emergency shoreline protection, Indian River County has sought, and is

likely to seek further, authorization for incidental take from the Service pursuant to Section 7 consultation with the U.S. Army Corps of Engineers. These authorizations will allow for the take of sea turtles along 8.3 miles of Atlantic coast beaches and 56 acres of nearshore hardbottom reef of Indian River County incidental to the Applicant's proposed plans to nourish its eroded beaches. As part of the revised countywide Beach Preservation Plan, four projects are scheduled to be phased in over a four-year period, commencing in 2003. Once each project has been built, it will be replenished at approximately eight-year intervals over the next 30 years.

On January 23, 2003, Indian River County received Department of the Army authorization to nourish one of four planned segments of critically eroded beaches in Indian River County. A Biological Opinion which included a take statement was issued by the Service authorizing: 1) destruction of all nests that may be constructed and eggs that may be deposited form March 1 through April 30 and from September 1 through September 30 and missed by a nest survey and egg relocation program within the boundaries of the proposed project: (2) destruction of all nests deposited from October 1 through February 28 (or 29 as applicable) when a nest survey and egg relocation program is not required to be in place within the boundaries of the proposed project; (3) reduced hatching success due to relocation; (4) harassment in the form of disturbing or interfering with female turtles attempting to nest as a result of construction activities; (5) disorientation and misdirection of hatchling turtles on beaches adjacent to the construction area as a result of project lighting; (6) behavior modification of nesting females due to escarpment formation within the project area during a nesting season, resulting in false crawls, or causes situations where females choose marginal or unsuitable nesting areas to deposit eggs; and (7) destruction of nests from authorized escarpment leveling activity.

Potential cumulative adverse impacts of beach nourishment may include destruction of nests deposited within the boundaries of the proposed project, harassment in the form of disturbing or interfering with female turtles attempting to nest within the construction area or on adjacent beaches as a result of construction activities, disorientation of hatchling turtles on beaches adjacent to the construction area as they emerge from the nest and crawl to the water as a result of project lighting, and behavior modification of nesting females due to escarpment formation within the project area during the nesting season resulting in false crawls or situations where they choose marginal or unsuitable nesting areas to deposit eggs. The quality of the placed sand could affect the ability of female turtles to nest, the suitability of the nest incubation environment, and the ability of hatchlings to emerge from the nest.

Potential beneficial effects of beach nourishment are discussed within the HCP and include the possibility that placement of sand on severely eroded beaches may increase sea turtle nesting habitat if the placed sand is compatible with naturally occurring beach sediments and compaction and escarpment remediation measures are incorporated into the project.

An analysis of take was presented in the Applicant's HCP and indicates that emergency shoreline armoring should neither be required, nor will it be allowed, at any location where an active beach nourishment project is in place. Thus, the County's beach nourishment projects may decrease the need for future shoreline armoring and reduce the adverse effects these structures pose for sea turtles and their nesting habitat. Additionally, beach restoration seaward of existing armoring structures may attenuate any reduction in nesting that might otherwise be attributable to the structures.

4.2.3.2 Migratory Birds

Migratory shorebirds may be harassed by movement, noise, and/or vibration of humans and equipment during construction activities. The quality of available nesting and resting habitat may also be affected by changes in the physical character of the beach following installation of armoring structures. However, the potential for these impacts are expected to be minimal, because in the absence of emergency shoreline protection measures, the highly eroded nature of the beach would render the available habitat largely sub-optimum. Following installation of permanent armoring, diminished habitat values will generally be ameliorated when the County's planned beach nourishment projects are initiated at the project site.

4.2.3.3 Other Species

The Preferred Alternative is not expected to adversely affect any other State or federally protected plant or animals. Because the properties potentially affected by the proposed action have been developed and are along eroding sections of coastline, they are unlikely to meet the habitat requirements of listed species within the Plan Area. Furthermore, during the type of shoreline erosion required to generate an emergency response, any remnants of native dune habitat would likely be destroyed.

4.2.4 Cultural Resources

The Preferred Alternative is not anticipated to have any direct effect on standing historical structures or archaeological resources within the Plan Area. Florida's State Historic Preservation Officer concluded that no significant cultural resources are likely to be affected by emergency shoreline protection activities (Attachment B). Even if historic properties were threatened by erosion, emergency permitting as allowed under the ITP would serve to preserve them.

4.2.5 Social Issues

As indicated elsewhere in this EA, shoreline armoring has the potential to interrupt natural longshore transport processes and can cause erosion on downdrift properties. Additionally, structures that jut into the inter-tidal zone can impede public access along the beach at high tide. Under, Section 161, FS, and Chapter 62B-33, FAC, FDEP is required to ensure continued safe public access to the beach during its review of permits for permanent armoring structures. If access is impeded, the permittee is required to provide alternative access. The County's long-term BPP is intended to

restore eroded beaches and should largely offset both of the negative impacts identified above.

As with most construction projects, noise and vibration may be associated with emergency shoreline protection activities. Additionally, construction activities on the beach may be an annoyance to traditional beach users. These impacts are expected to be short term and would only affect the beach and upland properties in the immediate vicinity of the project.

4.2.6 Economic Concerns

Armoring structures can be a cost effective method for protecting upland property. They also help preserve eligible structures quickly in times of emergency. Under the Preferred Alternative, the Applicant assumes that emergency permitting under local authorization will result in more effective and timely responses to severe erosion events. Presumably this will reduce losses or damage to private property. The 31 properties projected to require shoreline protection under the ITP have an estimated property value of over $11 million (ATM 1998).

4.2.7 Aesthetics

Shoreline armoring detracts from the natural beauty of the coastline. Increased armoring may result in fewer tourist visits, which could have an economic impact on the local economy. However, the County's long-term BPP should offset this negative consequence.

4.3 Alternative 3: Issuance of the ITP Independent of Other County Measures to Combat Shoreline Erosion (Alternative 3)

4.3.1 Physical Environment

In the absence of the County's long-term beach management program, the number of habitable structures likely to require shoreline protection would increase to 64. The direct physical effects of this alternative could result in the placement of armoring structures along 1.72 miles of beach. Even though all of the minimization measures contained in the Preferred Alternative would remain in effect, the amount of beach potentially impacted under Alternative 3 would nearly triple. The cumulative impact would increase to 2.80 miles or 12.6 percent of the County's coastline. Thus, assuming that impacts are proportional to the amount of shoreline armored, all of the physical impacts associated with the Preferred Alternative would increase by at least 65 percent under Alternative 3.

4.3.2 Land Use

As for the other alternatives, shoreline erosion has no relation to zoning or other County land-use classifications. However, in the absence of beach nourishment the

potential for loss or damage to upland structures would increase appreciably. This could affect property values and cause increased changes in ownership.

4.3.3 Biological Environment

Under Alternative 3, about twice as many structures are estimated to be vulnerable to erosion than under the Preferred Alternative (Issuance of the ITP in Conjunction With Shoreline Protection Measures Contained in IRC's Beach Preservation Plan). However, the amount of affected shoreline would nearly triple. Most importantly, without the mitigating effects of beach nourishment, armoring structures on or near the beach would continue to cause take over the 30-year life of the ITP. It is estimated that this would result in the destruction and displacement of 5,905 loggerhead, 287 green, and 23 leatherback nests. In each case, these numbers are more than five times greater than the take that would occur under the Preferred Alternative. About three percent of all loggerhead and green turtle nests and more than 4 percent of leatherback nests deposited on County Beaches would be affected. As discussed for the Preferred Alternative, the cumulative impacts would be disproportionately greater as the likelihood of nests being deposited in sub-optimum incubation environments would rise dramatically. Corresponding increases in the level of impacts to migratory shorebirds might also be expected.

4.3.4 Cultural Resources

As for the other alternatives, Alternative 3 would have relatively little impact on the County's cultural resources. Florida's State Historic Preservation Officer concluded that no significant cultural resources are likely to be affected by emergency shoreline protection activities (Attachment B).

4.3.5 Social Issues

Public access issues, construction noise, and annoyance to traditional beach users would be exacerbated under Alternative 3. Even though these impacts would be relatively short term at individual project sites, they would affect a much larger area and would occur over a much longer time span. The cumulative effect of armoring along 15 percent of the County's coastline could appreciably impact the recreational value of County Beaches.

Erosion to properties downdrift of seawalls and other armoring structures would become a proportionately greater problem under Alternative 3 than under the Preferred Alternative, as the extent of armored shoreline could potentially triple. This impact will be exacerbated in the absence of beach nourishment, as erosion will continue unabated over the life of the ITP. Under the Preferred Alternative, erosion would only occur from the time an armoring structure is built until the time a beach nourishment project is initiated at the site.

4.3.6 Economic Concerns

Under Alternative 3, the number of structures vulnerable to erosion would double, and the potential for loss or damage to those properties would increase proportionately. Thus, in the absence of beach nourishment, the County's ability to offer effective and timely responses to emergency erosion events becomes even more important.

4.3.7 Aesthetics

Shoreline armoring detracts from the natural beauty of the coastline. Under Alternative 3, armoring would affect 45 percent more coastline than under the Preferred Alternative. In the absence of beach nourishment, any deterioration in the quality of the beach experience as a result of armoring would be permanent. This could ultimately impact the local economy through a decline in tourism.

4.4 Alternative 4: Issuance of the ITP Under Conditions Less Favorable to Beach Armoring (Alternative 4)

4.4.1 Physical Environment

Alternative 4 assumes that the erosion model used to estimate the number of structures likely to be vulnerable to erosion over the 30-year life of the ITP (i.e. the Preferred Alternative) was too conservative. That is to say that more structures were determined to be vulnerable to erosion than may actually occur. Thus, rather than using the average rates of erosion in the vulnerability analysis for Alternative 4, minimum rates were used.

Minimum erosion rates in the Wabasso Beach area of the County were only 1/3 of average erosion rates. Consequently, it could be assumed that under Alternative 4, erosion would affect only a third of the structures estimated to be vulnerable under the Preferred Alternative. Similarly, about 40 and 75 percent, respectively, of the structures in Vero Beach and South County Beaches likely to be vulnerable to erosion under the Preferred Alternative would be affected under Alternative 4.

Although this alternative would affect a smaller percentage of the County's coastline, and is therefore preferable to the other action alternatives, it is used here primarily as a means of evaluating a reasonable range of possible outcomes related to the Applicant's proposed action. The Applicant has no control over erosion rates and thus cannot reasonably be expected to limit the number of structures that actually become vulnerable to erosion. The Service, on the other hand, could place a limit on the number of structures and/or the linear extent of shoreline for which the Applicant would be authorized to issue emergency shoreline protection permits under the ITP. However, even if the Service took this action, it would not necessarily limit the number of structures erected on the beach, as owners of eligible upland structures could still obtain emergency permits through the State of Florida.

4.4.2 Land Use

As for the other alternatives, Alternative 4 would have limited effect on land use patterns and upland activities.

4.4.3 Biological Environment

Under Alternative 4, total nest destruction and displacement over the 30-year life of the ITP would be reduced to 395 loggerhead, 19 green, and 1 leatherback nests. At current nest densities, this represents 0.23 percent of all loggerhead and 0.19 percent of all green and leatherback nests deposited on County Beaches over the 30-year life of the ITP. Thus, direct, indirect and cumulative impacts would all be reduced under this alternative relative to the other action alternatives. Corresponding decreases in the level of impacts to migratory shorebirds might also be expected. Although the Applicant may slow erosion through its beach nourishment projects, it cannot control erosion rates prior to nourishment events or in those areas of County Beaches where no nourishment projects are planned. Thus, the Applicant cannot affect the outcome predicted under this alternative.

4.4.4 Cultural Resources

As for the other alternatives, Alternative 4 would have relatively little impact on the County's cultural resources. Florida's State Historic Preservation Officer concluded that no significant cultural resources are likely to be affected by emergency shoreline protection activities (Attachment B).

4.4.5 Social Issues

Downdrift erosion, impediments to public access, construction noise, and annoyance to traditional beach users would all be minimized under Alternative 4, as relatively few armoring structures would be constructed.

4.4.6 Economic Concerns

Under Alternative 4, the number of structures vulnerable to erosion would decrease substantially relative to the other action alternatives. The potential for loss or damage to those properties would decrease proportionately. However, as noted above, this outcome would be more a chance of nature than deliberate action on the part of either the Applicant or the Service.

4.4.7 Aesthetics

Shoreline armoring detracts from the natural beauty of the coastline. Under Alternative 4, armoring would affect a smaller percentage of the shoreline than the other action alternatives. In conjunction with the County's planned beach nourishment projects, this alternative would maintain much of the beach/dune system in its present condition.

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ATTACHMENT A – SOLICITOR COMMENTS RE MOA

United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

October 18, 2001

Mr. Robert Ernest
Ecological Associates, Inc.
P.O. Box 405
Jensen Beach, Florida 34958

Dear Mr. Ernest:

In our continuing effort to assist Indian River County Board of County Commissioners in the successful completion of a Habitat Conservation Plan to address the take of federally listed sea turtles, we received comments from the Office of the Solicitor (Solicitor) regarding the legal sufficiency of the draft Memorandum of Agreement (MOA) between Indian River County and the Florida Department of Environmental Protection. We have attached a copy of the Solicitor's memorandum for your review.

Based on the limited comments provided by the Solicitor, we conclude that the MOA will satisfactorily unite Indian River County and the State of Florida armoring permitting processes. As a result, it is our understanding that a section 10 incidental take permit, if issued, would provide regulatory coverage from the prohibitions of take during both the emergency armoring permitting authorized by the County and any subsequent authorization by the State of Florida to make these same structures permanent.

Please incorporate the comments provided by the Solicitor into the draft MOA prior to finalization. If you have questions or need to discuss the recommended changes, please contact Mike Jennings of my staff at (561) 562-3909. Extension 225.

Sincerely yours,

James J. Slack
Field Supervisor
South Florida Ecological Services Office

1 Enclosure

ATTACHMENT B – SHPO STATEMENT RE CULTURAL RESOURCES

EAI

Ecological Associates, Inc.

Post Office Box 405 • Jensen Beach, Florida 34958

July 11, 2000

Ms. Janet Matthews
c/o Ms. Laura Kammerer
State Historic Preservation Officer
Division of Historical Resources
500 South Bronough Street
Tallahassee, Florida 32399-0250

RE: Indian River County Incidental Take Permit Application to USFWS

Dear Ms. Matthews:

Ecological Associates, Inc. (EAI) has been contracted by Indian River County to prepare a Section 10 Incidental Take Permit (ITP) Application to the U.S. Fish & Wildlife Service (USFWS). When issued, the ITP will protect Indian River County from the take of federally protected sea turtles causally related to emergency shoreline protection measures initiated under emergency authorization from the County.

Large sections of Indian River County's Atlantic shoreline are classified as severely eroded. The County has developed a comprehensive Beach Management Plan (BMP) that provides a systematic approach to restoring eroded beaches as a means of storm protection. However, until such time as the BMP is fully implemented, many beachfront structures will remain vulnerable to hurricanes and other destructive storms.

Under the proposed ITP, the County will issue emergency shoreline protection permits to existing eligible structures when erosion caused by severe storms makes them vulnerable to damage. Emergency permitting is a streamlined process that allows local governments to provide immediate relief to truly vulnerable structures, so affected property owners do not have to go through the normal and more protracted permitting process to protect their property. Very specific issuance criteria have been established for emergency permits to ensure that this expedited permitting process is not abused.

The emergency permitting program is geared toward habitable structures (homes, hotels, businesses) built before the state's Coastal Construction Control Line (CCCL) regulations went into effect. Undeveloped properties and non-essential structures (cabanas, gazebos, etc.) are ineligible for emergency protection. To be considered vulnerable, there must be less than 20 feet of property between the most seaward edge of the eligible structure and the adjacent dune escarpment. Additionally, the storm that

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caused the eligible structure to become vulnerable must be officially declared an emergency by Indian River County. Using these criteria, an erosion analysis performed by the County's coastal engineer estimated that only 31 structures would likely be eligible for an emergency permit over the next 30 years, provided the County's BMP is implemented on schedule.

In support of the ITP application, the USFWS will require that your office make a determination that no significant cultural resources are likely to be affected by the proposed action. The proposed action is the placement of temporary emergency structures (sand bags, wooden retaining walls, sheet pile, etc.) along the seaward edge of the dune escarpment immediately adjacent to the affected structure. Within 60 days of the time the emergency measures are completed, the affected property owner must either submit a complete application to the Florida Department of Environmental Protection (FDEP) for a permanent structure or remove the temporary structure. FDEP may subsequently authorize installation of a permanent seawall, rock revetment or other armoring structure at the site in accordance with existing rules and regulations. Some excavation may be required during installation of these structures, but it would be confined to the area (less than 20 feet) between the edge of the structure and the dune escarpment.

In an effort to determine if any of the 31 structures likely to be eligible for shoreline protection under emergency authorization are in areas where significant cultural resources exist, we requested that the County review the sites relative to its local archaeological database. Mr. Roland M. DeBlois, Chief of Environmental Planning & Code Enforcement, performed the analysis (attached). Mr. DeBlois is responsible for reviewing development projects with respect to their potential for impacting cultural and historical resources and is the County's staff liaison to the Archaeological and Historical Conservancy, Inc., a local non-profit archaeological preservation group. He concluded that there were no specific archaeological sites at the expected emergency protection locations. Although the entire barrier island is classified as a site of high probability for archaeological resources, most of the known resources are proximate to the Indian River Lagoon and not along the ocean bluff line where emergency protection would occur.

Considering that the affected properties have already been altered by development, including excavations for foundations, pools, wells, septic tanks, etc. and that the property between existing structures and the beach is eroding, the proposed action would appear to pose relatively little risk to significant archaeological resources. It could be argued that the proposed action might even be beneficial to cultural resources, if they exist, by protecting them against additional loss to shoreline erosion.

Based on the information provided, we respectfully request that you prepare a letter of findings indicating that the proposed action is unlikely to impact any significant

cultural resources. Should you require additional information to assist in making this determination, please do not hesitate to contact me at the address shown on the letterhead.

In advance, thank you for your assistance in this matter.

Sincerely,

Robert G. Ernest
President

RGE/re
enclosure

cc: J. Tabar/Indian River County
M. Jennings/USFWS

INDIAN RIVER COUNTY
MEMORANDUM

TO: Jeff Tabar, P.E.
Coastal Engineer

FROM: Roland M. DeBlois, AICP
Chief, Environmental Planning
& Code Enforcement

DATE: June 27, 2000

RE: **Sea Turtle HCP Emergency Protection Locations; Cultural Resources Review**

As requested, I have review aerials showing expected emergency protection locations associated with the county sea turtle habitat conservation plan (HCP) that is being developed.

The 1992 report "An Archaeological Survey of Indian River County, Florida" by The Archaeological and Historical Conservancy, Inc., does not identify any specific archaeological sites that would be affected at the locations of expected emergency protection. However, the report does classify the entire barrier island as "predicted or demonstrated high site density" with regards to archaeological site probability. Notwithstanding, the specific archaeological sites that have been documented on the barrier island tend to be proximate to the Indian River Lagoon and not at the ocean bluff line, where emergency protection would occur.

If you have any questions or require more information, please let me know.

Cc: Robert Keating

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DIVISIONS OF FLORIDA DEPARTMENT OF STATE
Office of the Secretary
Office of International Relations
Division of Elections
Division of Corporations
Division of Cultural Affairs
Division of Historical Resources
Division of Library and Information Services
Division of Licensing
Division of Administrative Services

MEMBER OF THE FLORIDA CABINET
State Board of Education
Trustees of the Internal Improvement Trust Fund
Administration Commission
Florida Land and Water Adjudicatory Commission
Siting Board
Division of Bond Finance
Department of Revenue
Department of Law Enforcement
Department of Highway Safety and Motor Vehicles
Department of Veterans' Affairs

FLORIDA DEPARTMENT OF STATE
Katherine Harris
Secretary of State

DIVISION OF HISTORICAL RESOURCES

Mr. Robert G. Ernest
Ecological Associates, Inc.
Post Office Box 405
Jensen Beach, Florida 34958

September 27, 2000

RE: DHR Project File No. 2000-05955
U.S. Fish & Wildlife Service
Indian River County Incidental Take Permit – Proposed Emergency Shoreline Protection
Indian River County, Florida

Dear Mr. Ernest:

In accordance with the procedures contained in 36 C.F.R., Part 800 ("Protection of Historic Properties"), we have reviewed the above referenced project for possible impact to historic properties eligible for listing in the National Register of Historic Places. The authority for this procedure is the National Historic Preservation Act of 1966 (Public Law 89-665), as amended.

We have reviewed the referenced Incidental Take permit and based on the information provided, it is the opinion of this office that no historic properties will be affected by this undertaking.

If you have any questions concerning our comments, please contact Scott Edwards, Historic Preservation Planner, at 850-487-2333 or 800-847-7278. Your interest in protecting Florida's historic properties is appreciated.

Sincerely,

Janet Snyder Matthews

Janet Snyder Matthews, Ph.D., Director
Division of Historical Resources
State Historic Preservation Officer

JSM/Ese

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☐ Director's Office (850) 488-1480 • FAX: 488-3353
☐ Archaeological Research (850) 487-2299 • FAX: 414-2207
☑ Historic Preservation (850) 487-2333 • FAX: 922-0496
☐ Historical Museums (850) 488-1484 • FAX: 921-2503
☐ Historic Pensacola Preservation Board (850) 595-5985 • FAX: 595-5989
☐ Palm Beach Regional Office (561) 279-1475 • FAX: 279-1476
☐ St. Augustine Regional Office (904) 825-5045 • FAX: 825-5044
☐ Tampa Regional Office (813) 272-3843 • FAX: 272-2340

ATTACHMENT C – IRC LIGHTING REGULATIONS

IRC LIGHTING ORDINANCE

tures shall be located in order to minimize negative impacts on shoreline vegetation and marine grassbeds, as applicable. On riparian property where the location of a waterfront structure over or in the vicinity of light-sensitive aquatic vegetation (such as sea grasses) is unavoidable, such structure (or portion thereof) shall be constructed a minimum of five (5) feet above the mean high water level where said aquatic vegetation exists or could potentially exist, as determined by county environmental planning staff. Said determination shall be based on staff review of seagrass inventory information and site specific conditions.
(Ord. No. 90-16, § 1, 9-11-90; Ord. No. 91-23, § 12, 5-15-91; Ord. No. 91-48, § 52, 12-4-91; Ord. No. 92-11, § 13, 4-22-92; Ord. No. 96-6, § 20, 2-27-96)

Section 932.08. Marina and multi-slip facilities.

The zoning and necessary specific criteria for commercial marinas, public/private docks and private multi-slip docking facilities are described in Chapter 971 regarding specific land uses and are applicable in this chapter.
(Ord. No. 90-16, § 1, 9-11-90)

Section 932.09. Sea turtle protection.

(1) *Purpose.* The purpose of this section is to protect the threatened and endangered sea turtles which nest along the beaches of Indian River County, Florida, by safeguarding the hatchlings from sources of artificial light.

(2) *New development.* It is the policy of the Indian River County board of county commissioners that no artificial light illuminate any area of the beaches of unincorporated Indian River County, Florida, during the period of the year when sea turtles nest. To meet this intent, building and electrical plans for construction of single-family or multifamily dwellings, commercial or other structures, parking lots, dune walkovers, and other outdoor lighting for real property, if lighting associated with such construction or development can be seen from the beach, shall be in compliance with the following:

(a) Floodlights shall be prohibited. Wall-mounted light fixtures shall be fitted with hoods so that no light illuminates the beach.

(b) Pole lights shall be shielded in such a way that light will not illuminate areas other than the specific property boundaries of the subject site and shall not illuminate the beach or dune area on the seaward side of the pole. Outdoor lighting shall be held to the minimum necessary for security and convenience.

(c) Low-profile luminaries shall be used in parking lots, and such lighting shall be positioned so that no light illuminates the beach.

(d) Dune crosswalks shall utilize low-profile shielded luminaries.

(e) Lights on balconies shall be fitted with hoods so that lights will not illuminate the beach.

(f) Tinted or filmed glass shall be used in windows and glass doors facing the ocean on single and multistory structures.

(g) Temporary security lights at construction-sites shall not be mounted more than fifteen (15) feet above the ground. Illumination from the lights shall not spread beyond the boundary of the property being developed, and in no case shall those lights illuminate the beach.

(3) *Beachfront lighting approval.* Prior to the issuance of a certificate of occupancy for any new development within view of the beach, compliance with the beachfront lighting standards set forth in this ordinance shall be approved as follows:

(a) Upon completion of the construction activities, the county environmental planner shall conduct a site inspection which includes a night survey with all beachfront lighting turned on.

(b) The environmental planner shall prepare and report the inspection findings in writing identifying:

1. The date and time of initial inspection;
2. The extent of compliance with the lighting standards;
3. All areas of observed noncompliance, if applicable;

4. Any action(s) taken to remedy observed noncompliance, if applicable.

The environmental planner, in cases where remedial action is necessary, shall notify the owner or developer of the results of the inspection and shall schedule a date and time for a subsequent inspection.

(4) *Existing development.* To meet the intent of this section, lighting of existing structures which can be seen from the beach shall be in compliance with the following:

(a) Lights illuminating buildings or associated grounds for decorative or recreational purposes shall be shielded or screened such that they are not visible from the beach, or turned off after 9:00 p.m. during the period from March 1 to October 31 of each year;

(b) Lights illuminating dune crosswalks of any areas oceanward of the dune line shall be turned off after 9:00 p.m. during the period from March 1 to October 31 of each year;

(c) Security lighting shall be permitted throughout the night so long as low-profile luminaries are used and screened in such a way that those lights do not illuminate the beach. The use of motion detector switches are encouraged.

(d) Window treatments in windows facing the ocean of single and multistory structures are required so that interior lights do not illuminate the beach. The use of tint or film on windows or awnings is preferred; however, the use of black-out draperies or shade screens will suffice.

(5) *Publicly owned lighting.* Street lights and lighting at parks and other publicly owned beach access areas shall be subject to the following:

(a) Whenever possible, street lights shall be located so that the bulk of their illumination will travel away from the beach. The lights shall be equipped with shades or shields that will prevent backlighting and render them not visible from the beach.

(b) Lights at parks or other public beach access points shall be shielded or shaded.

(Ord. No. 90-16, § 1, 9-11-90; Ord. No. 94-1, §§ 8B, 8C, 1-5-94)

Section 932.10. Manatee protection. (Reserved)

Section 932.11. Aquaculture/water dependent/water-related uses.

(1) *Aquaculture.* Any proposed aquaculture or mariculture related operation which locates within the surface waters of Indian River County shall be subject to the regulations of all federal, state and local authorities with appropriate jurisdiction. All marine-related aquaculture operations, including those exempted from federal or state regulations, shall be subject to the rules of this chapter, as applicable. All aquaculture operations or related operations shall obtain administrative approval from the community development director and shall meet the following minimum criteria:

(a) The use of privately owned bottom lands for aquaculture related purposes shall be permitted provided that:

1. There shall be no creation of new or expansion of existing bottom lands, or impoundment areas of the proposed site;

2. The area and water quality has been state approved for shellfish harvesting and/or propagation, or has been approved by the state for the specific use desired;

3. The activities associated with or incidental to the operation do not interfere with waterway rights or boating activities, reduce water circulation patterns or degrade existing water quality, adversely impact existing aquatic or shoreline vegetation, or are contradic-